

**Advancing Climate Literacy in  
Union Vocational Education and Training Programs in English  
Canada, Quebec, Europe and the US: Analysis, Findings and  
Lessons Learned**

**Appendix 2: Defining Climate Literacy**

## Defining Climate Literacy

*“Science as an enterprise does not only shape our daily lives in ways... it also serves as the foundation on which our culture is built and important economic and political decisions are made. Therefore, our individual, economic and political development especially in this 21st century depends on the scientific literacy of our citizenry.”<sup>1</sup>*

*“The magnitude and urgency of the climate change challenge cannot be understated. Canada’s economy, infrastructure, environment, health, and social and cultural well-being are already feeling its consequences, though these impacts are not experienced to the same degree by all Canadians. In response, Canada’s House of Commons declared a national climate emergency in June 2019”<sup>2</sup>*

### Presenting the definition

Climate literacy is a part of broader science literacy. It also incorporates concepts of environmental and ecological literacy. It evolved out of a growing need to understand how to respond to climate change. “The term environmental literacy was first used 45 years ago in an issue of the Massachusetts Audubon journal by Roth (1968) who inquired “How shall we know the environmentally literate citizen?”<sup>3</sup> The US National Oceanic Atmospheric Agency (NOAA 2009) framework echoes Roth’s question with regards to the climate, describing how one would define “a climate literate person....” and goes on to list the general principles it sees as critical to the definition. We have incorporated much of this into our definition.<sup>4</sup>

Many educators have adopted this framework. We follow in this tradition, laying out our synthesis of climate literacy principles as the starting point for our single page definition, to which we append an additional list, principles for “a climate literate person in construction.”

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<sup>1</sup> Osisioma, I. (2017). “Promoting Scientific Literacy: Strategies for Teaching Academic Language in Science” <https://www.researchgate.net/project/Promoting-Scientific-Literacy-Strategies-for-Teaching-Academic-Language-in-Science>

<sup>2</sup> Climate Science. (2020). Advancing Science and Knowledge on Climate Change [https://publications.gc.ca/collections/collection\\_2020/eccc/En4-414-2020-eng.pdf](https://publications.gc.ca/collections/collection_2020/eccc/En4-414-2020-eng.pdf)

<sup>3</sup> McBride, B. B. C. A. Brewer et. al. (2013). Environmental Literacy, Ecological Literacy, Ecoliteracy: What Do We Mean and How Did We Get Here? *Ecosphere*. Vol. 45, May p. 3. <https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1890/ES13-00075.1>

<sup>4</sup> NOAA (2009). [Climate Literacy: the Essential Principles of Climate Literacy](#). See also the definition of Energy Literacy on the same web site. The NOAA defines climate literacy as follows: *What is Climate Literacy? Climate Science Literacy is an understanding of your influence on climate and climate’s influence on you and society. A climate-literate person: understands the essential principles of Earth’s climate system; knows how to assess scientifically credible information about climate; communicates about climate and climate change; in a meaningful way; and is able to make informed and responsible decisions with regard to actions that may affect climate.* Much of the definition in this background paper is centered on North American and some European resources and ideas. This is a limitation as well as an invitation to expand on this work to be more multi-racial, multi-cultural and global.

In the following parts of this paper, we provide a fuller explanation of each of these points. What is climate literacy?

**Part A - a climate-literate person**

1. understands the essential principles of Earth's climate system, including the greenhouse gas (GHG) effect, knows how to access and assess scientifically credible information about climate, and communicate it to others,
2. respects ecological and Indigenous knowledges and practices that protect biodiversity and promote equitable and healthy ecosystems,
3. is aware that climate change is already affecting every inhabited region across the globe with human influence contributing to many observed changes in weather and climate extremes (IPCC)
4. knows that historical inequities in power and resources expose marginalized people disproportionately to climate change impacts,
5. understands that, in the short term at least, fighting climate change can have uneven and potentially disruptive effects on the economic and social well-being of people and communities,
6. is able to make informed decisions and actions that may affect climate and the environment and looks for ways to apply this knowledge responsibly.

**Part B - A climate-literate person in the trades (in addition to Part A)**

1. understands how the sources of energy, methods and materials used in their particular trade contribute to GHG emissions, and can apply environmental principles to practical workplace situations to reduce energy use and emissions,
2. grasps the link between environmental sustainability, social inclusion, equity, and strong labor standards to produce good green jobs and healthy communities,
3. with appropriate training, is able to make informed and responsible decisions, problem-solve, collaborate with others, and apply knowledge dynamically to enhance sustainability in the workplace,
4. recognizes the interconnectedness of all stakeholders during the life of the built environment, as well as those who live and work on the land over space and time.
5. is aware that the construction trades and related workers can play a unique role in addressing climate change and promoting healthy and safe energy and building projects that deliver quality work and serve people's needs,
6. has a holistic understanding of buildings, the role of their particular trade and how their activities interact and overlap with those of adjoining trades in producing a zero carbon environment
7. is able to adapt, adjust and integrate the knowledge, skills and competences required to exercise a particular trade to the exigencies of a zero carbon building.

**A BRIEF DEFINITION**

Briefly stated, climate literacy involves understanding how our everyday work and actions are part of a wider social and economic system that produces carbon emissions which are heating our planet. It recognizes that positive changes in society to promote biodiversity, sustainability, and equity in general, together with ecologically focused construction planning and practices may diminish the impact of climate change and improve our working and living environments.

## Methods and sources

Members of the Climate and Industry Research Team (CIRT) have diverse and grounded experiences with the construction industry. Among the team, some have worked in the industry, taught apprenticeship, been elected officers, and have studied the industry in various regions resulting in published articles and reports. CIRT members met together over several months to work on the definition of climate literacy, as well as conducting a literature review and an environmental scan. The latter is based on interviews with construction training directors, instructors, labor leaders and educators to learn about the practices with which low-carbon vocational training is being integrated into curriculum in Canada, the US and Europe.

The definition we arrived at draws from literature produced by government, independent scientific agencies, academic sources, Indigenous scholars, environmental NGOs and case studies written from community and union viewpoints. The objective of our climate literacy definition and this background paper is to write something useful for a broad audience with a focus on addressing the nature of training for climate awareness in the building trades.

Interpreting climate science, its social implications, and its relevance to construction workers is a practice that could be duplicated for workers in other sectors of our society beyond construction, such as media production, manufacturing or service industries where there are many different aspects of production, but workers are the ones who create the end result.

### Finding different perspectives, some commonalities

Scholarship on climate literacy contains points of commonality, but also potential areas of difference. Tensions and conflicts can be productive for understanding a range of positions, beliefs, and attitudes and for finding areas of consensus, a need for more information and dialogue. Why is it important to recognize the human factor in climate change? Do we need to acknowledge moving entirely away from fossil fuels or is it enough to embrace a green transition? Why is social inclusion and equity normally included in most definitions of climate literacy? How do Indigenous views inform and foster a deeper view of climate literacy? Why is fostering teamwork and worker voice in all stages of a project part of some definitions? The following paragraphs attempt to present the ideas and sources for our definition and clarify these questions.

#### Part A

##### 1. Starting with Science: The essential principles of Earth's climate system

Definitions of climate literacy, environmental literacy and related terms all address key aspects of climate science.<sup>5</sup> The scientific evidence of climate change is clear. While, historically, heat-trapping gasses helped maintain earth's life-sustaining atmosphere, the soaring level of CO<sub>2</sub> and other greenhouse gasses (GHGs) caused by human activity since the industrial revolution produces conditions that trap more heat, causing global warming. The Intergovernmental Panel

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<sup>5</sup> McBride, B. B. C. A. Brewer et. al. (2013). op. cit.

on Climate Change (IPCC) brings together literally thousands of the world’s best scientists from a wide range of scholarly disciplines to analyse the causes and impacts of climate change.<sup>6</sup> The US National Oceanic and Atmospheric Administration (NOAA) collects evidence of rising land and ocean temperature and maintains a database that track increases in CO2 and other greenhouse gasses which it publishes in its Annual Greenhouse Gas Index, the AGGI.<sup>7</sup> The IPCC and NOAA and are among the most widely referenced of the many scientific organizations that document climate science.<sup>8</sup>

The IPCC’s 2021 report is pivotal in attributing human activities as the cause of climate change, as well as documenting the deeply worrisome extent to which the surface of the planet is heating. The report states that it is “unequivocal that human influence warmed the atmosphere, ocean, and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere, and biosphere have occurred.” The document furnishes detailed evidence for this finding and the very high confidence level for each assertion it makes. The authors note the global rise in surface temperature has accelerated since 1850, even more so since 1950. “Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years.” The authors maintain that the scale of climate changes is “unprecedented over many centuries to many thousands of years.” Changes induced by global warming are increasing the frequency and size of weather events. “Wildfires, heat waves, droughts, flooding, and more are no longer “natural” disasters exclusively, because humanity has a substantial role in making many of them more extreme.”<sup>9</sup>

The key government sites for climate science noted above document the international expert consensus that can help people distinguish credible from unreliable sources. Critical analysis of climate science is useful for advancing debate when it comes from an informed and engaged knowledge foundation. Climate literacy, in other words, includes developing skills for the critical evaluation of sources.<sup>10</sup> NOAA’s definition notes that a climate literate person should also be able to communicate basic climate science to others.

We build on NOAA’s assertion that after attaining knowledge of the science, a person would “make informed and responsible decisions with regard to actions that may affect climate.” Our addition is that a climate literate person would not only make informed, responsible decisions about actions but would “look for ways” to apply their knowledge.<sup>11</sup> Studies show that just

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<sup>6</sup> Intergovernmental Panel on Climate Change (2014). The Physical Science Basis Summary for Policymakers [IPCC — Intergovernmental Panel on Climate Change](#)

<sup>7</sup> Butler, J. H., & Montzka, S. A. (2016, updated 2021). The NOAA annual greenhouse gas index (AGGI). *NOAA Earth System Research Laboratory*, 58; Warming influence of greenhouse gases continues to rise, NOAA finds, May 20, 2020 *NOAA Research News*. <https://research.noaa.gov/article/ArtMID/587/ArticleID/2626/Warming-influence-of-greenhouse-gases-continues-to-rise-NOAA-finds>

<sup>8</sup> Other resources include the Canadian Centre for Climate Service, [Canadian Centre for Climate Services - Canada.ca](#); Dzambo, A. M., Mooney, M., Handlos, Z. J., Lindstrom, S., Hang, Y., & Ackerman, S. A. (2020). An Interactive Online Course in Climate and Climate Change: Advancing Climate Literacy for Non-Atmospheric Science Majors. *Bulletin of the American Meteorological Society*, 101(10), E1697-E1708.

<sup>9</sup> IPCC (2021). op cit.

<sup>10</sup> See also: US National Oceanic and Atmospheric Administration. (2009) Climate Literacy: the Essential Principles of Climate Science: A Guide to Individuals and Communities. Washington: March.. [https://aambpublicoceanservice.blob.core.windows.net/oceanserviceprod/education/literacy/climate\\_literacy.pdf](https://aambpublicoceanservice.blob.core.windows.net/oceanserviceprod/education/literacy/climate_literacy.pdf)

<sup>11</sup> McBride et. al. (2013) p, 13.

knowing about climate change does not necessarily modify behavior.<sup>12</sup> We see climate literacy as knowledge that inspires and motivates people to act.

## 2. Indigenous Knowledge and Ecoliteracy

Part A of our definition begins with scientific climate principles and follows with recognizing the importance of Indigenous knowledge as part of ecoliteracy. We are not experts on ecoliteracy, nor have we had the direct support and insights of Indigenous peoples in the development of the approach to climate literacy we present, although we have read a number of studies that present their perspectives. This literature provides guidance on how concepts of sustainability clearly connect to the roots of their bodies of knowledge and demonstrate the significance of incorporating those concepts into principles for practice. Under this heading, we provide various resources on international and national examples of integrating Indigenous knowledge into our understanding of climate issues as well as incorporating key concepts of Indigenous sustainability.

On an international level, the IPCC recognizes Indigenous perspectives as “important resources for adapting to climate change... including Indigenous peoples’ holistic view of community and environment... that have not been used consistently.”<sup>13</sup> The Brundtland Report of 1987 and the UN Convention of Biological Diversity of 1993 both recognize that active engagement of Indigenous groups in society promotes biodiversity.<sup>14</sup>

Canada is among the nations that incorporate Indigenous knowledge in setting forth its principles on climate change. The first two guiding principles of Climate Science 2050, a 2020 publication of Environment and Climate Change Canada,<sup>15</sup> are to “ 1) Ensure equity of diverse knowledge systems, making space for Indigenous leadership and innovation, and recognizing that Indigenous Knowledge is a distinct network of knowledge systems that cannot be integrated into western science but that there are spaces where the two can co-exist and co-create knowledge, 2) Further Indigenous self-determination in research to support an approach to climate change research that is holistic, place-based, and responsive, and that respects Indigenous sovereignty and ownership of data and Indigenous Knowledge.” In addition to these goals, the document

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<sup>12</sup> Javeline, D., Kijewski-Correa, T., & Chesler, A. (2019). Does it matter if you “believe” in climate change? Not for coastal home vulnerability. *Climatic Change*, 155(4), 511-532.

<sup>13</sup> (IPCC 2014 as quoted in Dhillon 2018)

<sup>14</sup> United Nations World Commission on Environment and Development. (1987) Our Common Future. (Brundtland Report) Oslo: [1987: Brundtland Report \(admin.ch\)](#). Louis Bruyere, President of the Native Council of Canada, is quoted in the Brundtland Report, (also called Our Common Future): “Indigenous peoples are the base of what I guess could be called the environmental security system. We are the gate-keepers of success or failure to husband our resources. For many of us, however, the last few centuries have meant a major loss of control over our lands and waters. We are still the first to know about changes in the environment, but we are now the last to be asked or consulted...” <https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf> . See also: Herrera Izaguirre 2008.

<sup>15</sup> indigenous-led climate change science and knowledge. <https://Indigenousclimatehub.ca/2021/02/climate-science-2050-mobilizing-Indigenous-led-research-and-knowledge-on-climate-change/> referring to Climate Science 2050: Advancing Science and Knowledge on Climate Change. See also Canada’s Partnership with Indigenous Peoples on Climate, [https://publications.gc.ca/collections/collection\\_2020/eccc/En4-414-2020-eng.pdf](https://publications.gc.ca/collections/collection_2020/eccc/En4-414-2020-eng.pdf) <https://www.canada.ca/en/environment-climate-change/services/climate-change/Indigenous-partnership.html>

states that “[T]he equal and respectful co-development of climate change research and knowledge involving multiple knowledge systems can also serve as a mechanism through which long-term, meaningful partnerships can be fostered between researchers and Indigenous partners. This enables Canadian research to better respond to the unique and distinct research needs and interests of First Nations, Métis, and Inuit communities”<sup>16</sup>

North American governments were influenced by the Six Nations’ struggle to create a democratic coalition, one that would sustain itself.<sup>17</sup> One of its basic principles is that decisions should be made to meet the needs of the seventh generation to come. That is a first test of sustainability.

“In our way of life, in our government, with every decision we make, we always keep in mind the Seventh Generation to come. It’s our job to see that the people coming ahead, the generations still unborn, have a world no worse than ours- and hopefully, better. When we walk upon Mother Earth, we always plant our feet carefully because we know the faces of our future generations are looking up at us from beneath the ground, we never forget them.”<sup>18</sup>

As argued by both LaDuke and McGregor, Indigenous principles of sustainability are based on respect for the land and all of creation, for the cycles of nature, and the need for reciprocity between humans and nature.<sup>19</sup> “Cyclical thinking, common to most Indigenous or land-based cultures and value systems, is an understanding that the world (time, and all parts of the natural order-including the moon, the tides, women, lives, seasons, or age) flows in cycles. Within this understanding is a clear sense of birth and rebirth and a knowledge that what one does today will affect one in the future, on the return.”<sup>20</sup> Reciprocity has to do with the understanding that all animate and inanimate beings are sacred and that their life is not taken without an offering and the realization that “you take what you need and leave the rest” (Ibid).

McGregor like LaDuke, explains the Anishinaabe philosophy of *mino-mnaamodzawin* (“living well” or “the good life”), in which “mutually respectful and beneficial relationships among not only peoples but all our relations (including all living things and many entities not considered by Western society as living, such as water and Earth itself)”<sup>21</sup> McGregor argues that this principle should constitute a new ethical code of conduct. It encourages a climate literate person to reflect on these ideas of sustainability.

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<sup>16</sup> Ibid. p. 9.

<sup>17</sup> <https://www.pbs.org/native-america/blogs/native-voices/how-the-iroquois-great-law-of-peace-shaped-us-democracy/>

<sup>18</sup> Oren Lyons, Faithkeeper of the Turtle Clan of the Onondaga Nation and Spokesman for the Iriquois Confederacy, as quoted in Arden, H., & Wall, S. (1990). *Wisdomkeepers: Meetings with Native American Spiritual Elders*. Beyond Words Publishing, Inc.

<sup>19</sup> McGregor, D. (2004). Coming full circle: Indigenous knowledge, environment, and our future. *American Indian Quarterly*, 28(3/4), 385-410; McGregor, D. (2004). Traditional ecological knowledge and sustainable development: Towards co-existence. In M. Blaser, H. Feit, & G. McRae (Eds.), *In the way of development: Indigenous peoples, life projects and globalization* (pp. 72-91). New York: Zed Books; LaDuke, W. (1994). Traditional ecological knowledge and environmental futures. *Colorado Journal of International Environment and Policy Vol. 5.*, p. 127.

<sup>20</sup> LaDuke, op cit.

<sup>21</sup> McGregor, op. cit. p. 7

By including respect for Indigenous ecological knowledge, the definition of climate literacy reflects the tension between the values of colonial development and both Indigenous and an ecoliterate approach based on a kinship with nature.<sup>22</sup> The tension manifests itself in stand-offs over pipelines, dams, and other kinds of development. Many Indigenous groups defend their traditional relationship with land and culture and feel threatened not only by industrial, fossil fuel, and urban development but also by the intrusion of renewable energy companies into their territories.

The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) which Canada has ratified, laid the foundation for institutionalizing Indigenous sovereignty in the principle of Free, Prior and Informed Consent (FPIC) in 2007 to legitimize the right to self-determination and “effectively determine the outcome of decision-making that concerns them, not merely a right to be involved”.<sup>23</sup> Reflection on the values of *mino-mnaamodzawin* and upholding the policy of FPIC offer the public the opportunity to contemplate not only how to combat climate change, but also analyze the forces and values that produced the unsustainable societies we live in.

Integrating Indigenous perspectives into a climate literacy definition builds on the ecoliterate concept of creating “sustainable human communities that will preserve resources for future generations”<sup>24</sup>. Our wording identifies the importance of ecological knowledge for protecting biodiversity and promoting equitable and healthy ecosystems. Such a description connects the scientific with the social and material or everyday dimensions of climate literacy.

### **3. Climate change is everywhere and is tied to human influence**

The 2021 report of the IPCC paints a picture of the impact of human induced climate change on the world as noted in section A3,<sup>25</sup> as well as in the (IPCC) Working Group 1 contribution to the 6th Assessment Report (AR6): Climate Change 2021: The Physical Science Basis.” Masson-Delmotte and Panmao Zhai, writing for the World Meteorological Organization, identify key observations in that report that have had an impact around the world. Coastal regions are already grappling with the salinization of aquifers from sea-level rise.<sup>26</sup> The IPCC provides statistics over time on extreme sea levels, temperature extremes, frequency, intensity and amount of precipitation, agricultural droughts and heatwaves, precipitation associated with intense tropical cyclones.

“The frequency and intensity of heavy precipitation events have increased since the 1950s over most land areas for which observational data are sufficient for trend analysis (in particular, North America, Europe, and Asia), and human-induced climate change is likely the main driver. Human-induced climate change has contributed to increases in agricultural and ecological

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<sup>22</sup> McBride et al, 2013

<sup>23</sup> See also Agnes Portalewska <https://www.culturalsurvival.org/author/agnes-portalewska?page=2>

<sup>24</sup> McBride et al, 2013.

<sup>25</sup> Eckstein, D., Künzel, V., Schäfer, L., & Winges, M. (2019). Global climate risk index 2020. *Bonn: Germanwatch*. also Huang, H. H., Kerstein, J., & Wang, C. (2018). The impact of climate risk on firm performance and financing choices: An international comparison. *Journal of International Business Studies*, 49(5), 633-656.

<sup>26</sup> Werner, A. D., & Simmons, C. T. (2009). Impact of sea-level rise on sea water intrusion in coastal aquifers. *Groundwater*, 47 (2), 197-204.



droughts in drying regions due to increased land evapotranspiration. Human influence has likely increased the chance of compound extreme events since the 1950s (extreme heat, droughts, fire weather and flooding). Global mean sea level rose around 0.20 metres from 1901 to 2018, and the rate of rising has accelerated since the late 1960s. Projected changes in extremes are larger in frequency and intensity with every increment of global warming. Every region will increasingly experience concurrent and multiple changes.”<sup>27</sup>

Understanding how profound a change is taking place around the world requires recognizing our own experience and how weather patterns in our location have changed over time. It is the consensus of the scientific community, taking data from the historical record and contemporary events that informs us of how vast the changes are, and how much they are connected to the last few hundred years of human impact on the environment.

#### **4. Historical inequities expose marginalized people disproportionately to climate change**

Whether looking around the world or within nations, there are groups who are especially exposed to climate change. A number of studies provide insights into the meaning of this statement and argue that exposure is not a static condition, but one that has the potential for adaptation and resilience.

The World Bank explains that “[A]s the impacts of climate change mount, millions of vulnerable people face disproportionate challenges in terms of extreme events, health effects, food, water, and livelihood security, migration and forced displacement, loss of cultural identity, and other related risks. Certain social groups are particularly vulnerable to crises, for example, female-headed households, children, persons with disabilities, Indigenous Peoples and ethnic minorities, landless tenants, migrant workers, displaced persons, sexual and gender minorities, older people, and other socially marginalized groups. The root causes of their vulnerability lie in a combination of their geographical locations; their financial, socio-economic, cultural, and gender status; and their access to resources, services, decision-making power, and justice.”<sup>28</sup> A number of these characteristics can be addressed by confronting the forces of inequality that underlie these already existing categories.

While the descriptions above include populations in industrialized countries, attention is crucially important for the poor in developing areas and geographically exposed locations. As a study from the International Food Policy Research Institute (IFPRI) explains, “in developing countries, climate change will cause yield declines for the most important crops” with South Asia being especially affected.<sup>29</sup> People living in coastal regions are sensitive to [S]ea level rise,

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<sup>27</sup> Valérie Masson-Delmotte and Panmao Zhai. (2022)., Regional trends in extreme events in the IPCC 2021 report, Bulletin : Vol 71 (1) - 2022. <https://public.wmo.int/en/resources/bulletin/regional-trends-extreme-events-ipcc-2021-report>

<sup>28</sup> The World Bank. ( n.d.). Social Dimensions of Climate Change. <https://www.worldbank.org/en/topic/social-dimensions-of-climate-change>.

<sup>29</sup> International Food Policy Research Institute. (2009). p. viii; Tougas, R. K., & Arshad-Ayaz, A. (2021). Global Warming and the Disproportionate Impacts of Climate Change on the Global South. Also, Roy, S. S. (2018). Climate change in the global south: trends and spatial patterns. In *Linking Gender to Climate Change Impacts in the Global South* (pp. 1-25). Springer..

tropical cyclones, saltwater intrusion, and coastal flooding along with many other natural hazards [which] are increasingly common in many parts of the world, and regions like coastal Bangladesh are at the frontline of these impacts” Also low lying areas along all coasts and islands like the Republic of the Marshall Islands and other small islands are exceedingly vulnerable.<sup>30</sup>

The most comprehensive study of the worrisome impacts of climate change to date is the IPCC Sixth Assessment (2022) report entitled, “Impacts, adaptation and vulnerability.” It not only identifies areas of risk but also looks at prospects for positive change, exploring both “future impacts at different levels of warming and the resulting risks, and [also] offers options to strengthen nature’s and society’s resilience to ongoing climate change, to fight hunger, poverty, and inequality and keep Earth a place worth living on – for current as well as for future generations.” Various chapters focus on “ecosystems, water, food, cities, human health, communities and livelihoods...regional and sub-regional levels for Africa, Asia, Australasia, Central and South America, Europe, North America and Small Islands... regionalisation including polar regions, tropical forests, deserts, mountains and the Mediterranean, as well as highlighting the topics of biodiversity hotspots and cities by the sea...observed impacts and projected risks at regional and sub-regional levels for Africa, Asia, Australasia, Central and South America, Europe, North America and Small Islands. They assess adaptation options including limits, barriers, and adaptive capacity, as well as the interaction of risks and responses for climate resilient development”.<sup>31</sup>

## **5. There are uneven and potentially disruptive effects on people and communities**

In many ways, modern society is dependent on the fossil fuel industry. Shifting the economy away from oil, coal and gas extraction and use is an emerging challenge that involves many scales of decision-making. These include the commitment to renewable energy sources, producing low-carbon materials, creating circular economies, and decreasing consumption. Fundamentally, there is a conflict between the idea of shifting to green growth and that of a green transformation that directs us towards a more equitable society based on ideas of climate jobs, human well-being and *bienvivir*.<sup>32</sup> To some extent this difference in direction is also reflected in how to negotiate a transition that addresses the needs of workers, the locations they live in, the multiplier effect of change on connected industries and communities that can extend across many spaces. Scaling back or shutting down fossil fuel facilities leaves brownfields and pollution for generations to come. Who is responsible for negotiating and paying for these

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<sup>30</sup> Atapattu, S. (2021). Climate change, human rights, and poverty: intersections and challenges. In *Research Handbook on Human Rights and Poverty*. Edward Elgar Publishing. also Gerhardt, C. (2020). Sea level rise, Marshall Islands and environmental justice. In *Climate Justice and Community Renewal* (pp. 70-81). Routledge.

<sup>31</sup> See for example: Barca, S. (2015) p. ix. Greening the job: trade unions, climate change and the political ecology of labour. In *The international handbook of political ecology*. Edward Elgar Publishing; Kothari, A., Demaria, F., & Acosta, A. (2014). Buen Vivir, degrowth and ecological Swaraj: Alternatives to sustainable development and the green economy. *Development*, 57(3), 362-375; Pörtner, H. O., Roberts, D. C., Adams, H., Adler, C., Aldunce, P., Ali, E., Begum, R.A., Betts, R., Kerr, R.B., Biesbroek, R. and Birkmann, J. (2022). Climate change 2022: Impacts, adaptation and vulnerability. IPCC Sixth Assessment Report.

<sup>32</sup> For example, Bartelmus, P. (2013). The future we want: Green growth or sustainable development?. *Environmental Development*, 7, 165-170. Mah, A. (2021). Ecological crisis, decarbonisation, and degrowth: The dilemmas of just petrochemical transformations. *Stato e mercato*, 41(1), 51-78.

transitions, whose voices are heard and how they exert power, are among the many issues involved in what has come to be known as a Just Transition. These ramifications clarify that in addition to socio-technical changes, equity and social inclusion play important roles in conceptualizing and implementing green transitions.

The concept of Just Transition emerged from the labor movements in the US and Canada, in which leading unions recognized as early as the 1970's that transition policies were necessary for workers to avoid the suffering inherent in past transitions that left workers and communities in various states of devastation.<sup>33</sup> A recent study of transitions in the United States begins with the statement that:

“transitions are constant and inevitable, but they do not have to be unjust. Government policies have successfully supported the shift away from coal in several European countries, providing wage replacement, a bridge to pension, investment in new employment to a region, and much more. Without clear plans though, the harshness of job loss can lead to long term decline of a region. The scale and scope of the transition plan needs to go beyond only the fossil fuel workers and expand the possibility of a wide range of people to benefit from the shift to a low carbon economy.”<sup>34</sup>

Just Transition has been taken up as a concept around the world, especially after its inclusion in the Preamble to the Paris Agreement in 2015. In Europe and a number of other countries like Canada, governments are creating various bodies to oversee transitions.<sup>35</sup> Scholars have identified many of the issues that face, for example, the Canadian government, corporations, unions, and communities.<sup>36</sup>

Apart from the considerations of what energy sources to keep in or move towards is whom to include and on what scale. Mertins-Kirkwood, H., & Deshpande frame the issue of equity around the considerations of which workers and communities are encompassed by a transition plan for coal in their 2019 report for the Canadian Centre for Policy Alternatives and York University based research network Adapting Canadian Work and Workplaces to Respond to Climate

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<sup>33</sup> For example, Stevis, D. (2021). Embedding Just Transition in the USA: The Long Ambivalence. In *The Palgrave Handbook of Environmental Labour Studies* (pp. 591-619). Palgrave Macmillan, Cham. Stevis, D., & Felli, R. (2015). Global labour unions and just transition to a green economy. *International Environmental Agreements: Politics, Law and Economics*, 15(1), 29-43.

<sup>34</sup> Cha, J. M., Stevis, D., Price, V., & Vachon, T. E. (2021). Workers and communities in transition: Report of the Just Transition Listening Project. [https://www.labor4sustainability.org/files/JTLP\\_report2021.pdf](https://www.labor4sustainability.org/files/JTLP_report2021.pdf) also Cha, J., Pastor, M., Wander, M. (2019), A Roadmap to an Equitable, Low-Carbon Future: Four Pillars for a Just Transition [https://dornsife.usc.edu/assets/sites/242/docs/JUST\\_TRANSITION\\_Report\\_FINAL\\_12-19.pdf](https://dornsife.usc.edu/assets/sites/242/docs/JUST_TRANSITION_Report_FINAL_12-19.pdf)

<sup>35</sup> See Just Transition Platform (EU) <https://eprc-strath.org/just-transition-platform/> and Canada's discussion of a people-centered just transition advisory group: <https://www.rncanengagenrcan.ca/en/collections/just-transition> and Canada's coal transition task force: <https://www.canada.ca/en/environment-climate-change/services/climate-change/task-force-just-transition.html>

<sup>36</sup> For example, see Keough, N. (2021). Sustainability matters: Prospects for a just transition in Calgary, Canada's Petro-City (p. 256). University of Calgary Press. Evans, G., & Phelan, L. (2016). Transition to a post-carbon society: Linking environmental justice and just transition discourses. *Energy Policy*, 99, 329-339. Fusco, L. M., Schutter, M. S., & Cisneros-Montemayor, A. M. (2022). Oil, Transitions, and the Blue Economy in Canada. *Sustainability*, 14(13), 8132. Mertins-Kirkwood, H. (2018). Making decarbonization work for workers (Vol. 12). Canadian Centre for Policy Alternatives.

Change, “Who is included in a Just Transition. Considering social equity in Canada’s shift to a zero-carbon economy.”<sup>37</sup> They look at the equity framework in which coal workers are included (e.g. only directly employed, not contract workers or specialty workers), with no provisions for service sectors (particularly private sector health workers who support these workers). The authors note that even within the coal industry, workers are stratified demographically, with women, Indigenous and racialized groups, immigrants all earning less than white males, so that their benefits would be less in the transition plan. In addition, the industries to which these workers may transfer are also highly stratified, and in the emerging “clean industries” unionization is low so all workers would be making a lower wage. Many others reinforce these arguments, such as Pollin and Callaci who make similar arguments in their study of transition in the United States, Cozzi and Motherway of the International Energy Agency.<sup>38</sup>

The myriad concerns for addressing the issues facing workers and communities in a green transition are an integral part of climate literacy. This section has not looked beyond North America, but the questions facing nations across Europe Asia, Africa and Latin America are necessary to understand. They involve questions of decolonization in general, and many particularities such as how housing, education, extraction of resources for the green economy will be organized.

## **6. Can make informed decisions about climate change impacts and the environment and how to apply this knowledge responsibly.**

It is hard to absorb the nature of climate change without meaningful communication of scientifically based curriculum delivered in ways that learners can reflect on and integrate into

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<sup>37</sup> Mertins-Kirkwood and Clay Duncalfe. (2021). Roadmap to a Canadian Just Transition Act: A path to a Clean and Inclusive Economy. Ottawa: Canadian Centre for Policy Alternatives. <https://www.policyalternatives.ca/roadmap>; Mertins-Kirkwood, Hadrian and Zaeesh Deshpande. (2019) Who is Included in a Just Transition: Considering Social Equity in Canada’s Shift to a Zero-Carbon Economy. Canadian Centre for Policy Alternatives. Ottawa: [https://justtransitionforall.com/wp-content/uploads/2022/11/Who-is-included-in-a-just-transition\\_final.pdf](https://justtransitionforall.com/wp-content/uploads/2022/11/Who-is-included-in-a-just-transition_final.pdf)

<sup>38</sup> For example: Pollin, Robert, and Brian Callaci. "The economics of just transition: a framework for supporting fossil fuel-dependent workers and communities in the United States." *Labor Studies Journal* 44, no. 2 (2019): 93-138. <https://lpdd.org/wp-content/uploads/2020/03/WP423.pdf>. “ In considering the broader social context for a Just Transition program, we need to also recognize the major gender and ethnic disparities that will occur both as the fossil fuel industry contracts and the Just Transition program advances. The basic point is straightforward: U.S. fossil fuel industry employment is, at present, dominated by white males. Thus, as of 2015, women account for only 5.2 percent of overall employment in the coal industry, 18.3 percent in oil and gas extraction, and 13.2 percent in all mining support activities. African Americans accounted for only 1.5 percent of employment in coal, 3.5 percent in oil and gas, and 6.1 percent in support activities. This means that white men will be disproportionately hurt as the fossil fuel industry contracts but should also disproportionately benefit through a Just Transition program. It is also true that a disproportionate share of jobs in the clean energy industries will be created within the traditionally male-dominated manufacturing and construction industries.7 The most effective way to reverse such gender and ethnic disparities is to support affirmative action within the growing clean energy sectors. Such measures will be facilitated by the fact that the growing clean energy economy will generate an abundance of overall job opportunities—more than enough to provide reemployment for displaced fossil fuel industry-dependent workers, who will be mostly white males, as well as large numbers of new opportunities for both women and minority workers 95. See also Canada <https://www.catalyst.org/research/women-in-energy-gas-mining-oil/> ; Cozzi, L., & Motherway, B. (2021). The importance of focusing on jobs and fairness in clean energy transitions. <https://www.iea.org/commentaries/the-importance-of-focusing-on-jobs-and-fairness-in-clean-energy-transitions>

their own understanding and experience. Learning climate science means seeing its relevance and how to apply the knowledge effectively.

Abundant scholarship argues that a) misinformation about climate abounds, b) mere exposure to processes and impacts of climate change will not change attitudes or behavior. For people to make informed decisions and apply their knowledge to address climate change, they also need to see that what they do matters. As Molthan-Hill et al state, “The importance of making learning about climate change personally and contextually relevant is a recurrent theme across CCE literature which focuses on universities, schools, and communities”<sup>39</sup> Dupigny Giroux summarizes how her students defined climate literacy at the end of her course, namely “as the understanding of the “interconnectedness” of patterns at varying spatial and temporal scales, the ‘complexity’ of the interactions over these scales, the role that humans exert, and the ability to “act accordingly” having understood the above.”<sup>40</sup>

Taiwanese scholars emphasize the importance of having an educated and motivate citizenry to combat the effects of climate change that threaten biological diversity and human society. It is fitting to close with a quotation from Yu, et al (2020)<sup>41</sup> arguing that learning about climate change reduces confusion and can motivate pro-environmental action.

“From the perspective of green education, providing knowledge related to climate change and promoting pro-environmental behaviors is imperative.... We found that higher levels of knowledge significantly predicted greater perceptions of risk related to biodiversity threats and increased public costs. In terms of behavior, students with lower levels of knowledge were significantly more likely to find uncertainties related to climate change to be a greater obstacle to engaging in pro-environmental behaviors. Higher levels of knowledge clearly allow individuals to better assess the threats posed by climate change and reduces the perceived level of uncertainty related to climate change and the impact of pro-environmental behaviors. Our results suggest that Taiwan’s efforts to implement climate change related information in the public schools and in the university system have been effective and that such efforts should be broadened to reach the public as a whole” (p.24749).

## **Part B**

### **Introduction: Why We Need a Definition for the Construction Workforce**

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<sup>39</sup> Molthan-Hill, P., Blaj-Ward, L., Mbah, M. F., & Ledley, T. S. (2022). Climate change education at universities: Relevance and strategies for every discipline. In *Handbook of Climate Change Mitigation and Adaptation* (pp. 3395-3457). Cham: Springer International Publishing. The authors reviewed scholarship from industrialized societies and the developing world, and noted that analysts from the developing world identify among the challenges that, for example at “the University of South Africa’s College of Education, is to calibrate the extent to which discussion of environmental issues is decolonized and aligned with the lived realities of the students within the African context.

<sup>40</sup>Giroux, Dupigny L. A. L. (2010). Exploring the challenges of climate science literacy: Lessons from students, teachers and lifelong learners. *Geography Compass*, 4(9), 1203-1217.

<sup>41</sup> Yu, T. K., Lavallee, J. P., Di Giusto, B., Chang, I., & Yu, T. Y. (2020). Risk perception and response toward climate change for higher education students in Taiwan. *Environmental Science and Pollution Research*, 27(20), 24749-24759.

This section is an effort to explain climate literacy and discuss how it can enhance and broaden the knowledge, skills, competencies, even the philosophy of workers and the culture of the construction industry. Climate literacy has a particular significance for the construction industry and its workforce because buildings are such major contributors to climate change. They are the third largest source of emissions behind fossil fuel extraction and transportation in Canada. The entire building process and its outputs contribute to GHG emissions and energy use. This includes the manufacturing of building materials, transporting them to and from job sites, carrying out the actual building process, occupant consumption of energy in the resulting buildings and infrastructure and the eventual decommissioning of buildings at the end of their service life. The construction process impacts the environment in numerous ways including water use, air and water pollution, chemical run-offs, the generation of large volumes of waste and changes to the way in which the land itself is used. This is why reducing construction related GHG emissions and energy use is such a large component of the Canadian government's climate policy agenda.

The positive news is that the construction industry has the potential to make an enormous contribution to meeting Canada's climate goals. The 2014 IPCC report on mitigation of climate change (AR5) included an entire chapter discussing the numerous ways in which the climate footprint of the industry and the buildings and infrastructure it produces can be reduced. It argued that existing, well proven technologies already enable us to make a huge impact in cutting emissions if effectively utilized. Other, more recent studies have reinforced this view. The Canadian Government has echoed this in stating its climate priorities in its 2030 Emissions Reduction Plan:

“Much of the technology needed to decarbonize the buildings sector exists today. For example, electrification of heating by switching from fossil-fuels (e.g. oil, natural gas) to electric heat pumps is an economic and viable option in most parts of Canada, particularly as electrical grids expand capacity and decarbonize in parallel. Energy efficiency measures such as upgrading the building envelope with improved insulation, replacing windows and doors, or air sealing are also essential for decarbonization. Combined with fuel switching, energy efficiency can lower heating and cooling loads, minimize demand on the electricity grid, help control energy costs, and reduce the cost of heating with low-carbon technologies.”<sup>42</sup>

Canadian NGOs including the Canada Green Building Council and Passive House Canada have echoed these views, emphasizing that moving towards net zero is both feasible and economically possible.<sup>43</sup>

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<sup>42</sup> [Canada's 2030 Emissions Reduction Plan - Chapter 2 - Canada.ca](#)

<sup>43</sup> Canada Green Building Council. (2019) Making the Case for Building to Net Zero Carbon: Ottawa: February [https://www.cagbc.org/wp-content/uploads/2022/01/Making\\_the\\_Case\\_for\\_Building\\_to\\_Zero\\_Carbon\\_2019\\_EN.pdf](https://www.cagbc.org/wp-content/uploads/2022/01/Making_the_Case_for_Building_to_Zero_Carbon_2019_EN.pdf); Passive House Canada (2021) Submission to the National Infrastructure Assessment. July 29. <https://www.passivehousecanada.com/wp-content/uploads/2021/07/Passive-House-Canada-Submission-on-National-Infrastructure-Assessment.pdf> Freihaut, James and Lisa Tryson (2017) High Performance: Making the Buildings-Energy Equation Sustainable: Practices, Paths and Technologies Available Now to Achieve Transformative Building and Energy Innovation. Danfoss Engineering. March. [https://www.passivehousecanada.com/wp-content/uploads/2017/04/Danfoss\\_High-Performance-Report\\_Danfoss-PSU-1-1.pdf](https://www.passivehousecanada.com/wp-content/uploads/2017/04/Danfoss_High-Performance-Report_Danfoss-PSU-1-1.pdf)

Training and upgrading education are the foundation of the building trades whose members must be able to work with complex systems and materials and solve problems on the work site using their knowledge, skills and acquired competencies. While few trades talk about climate change, many apprenticeship programs do teach skills for green construction under the heading of energy efficiency and many journey persons are already taking upgrade courses to equip them for the new technologies and building systems being introduced. Building codes and project specifications increasingly require projects to meet energy saving objectives which working trades are expected to deliver.

The building trades and related workers are at the center of many economic, political, social, and cultural forces. The unionized sector especially is sensitive to public opinion and repeatedly has to make its case that the high quality construction standards its members deliver contribute important value to the economy and society and, specifically, can contribute substantially to addressing climate change.

Some look at the shift to renewables as simply green growth, that is doing more of the same with a bit more concern for the environmental and sustainability impacts of construction. However, climate literacy includes a more transformative perspective that encourages us to shift our way of life towards a sustainable, more equitable society, one that preserves the environment and its complex biodiversity.<sup>44</sup> “The United Nations Environment Program (UNEP) defines a green economy as an economy that addresses a reduction in carbon outputs, while demonstrating resource efficiency and social inclusivity”.<sup>45</sup>

As the public demands increasing attention to the climate crisis, industry and labor unions must respond. Unions invest heavily in educating their members with the knowledge, skills and competencies that can facilitate industry transformation. They are very good at teaching the ‘how’ of performing competent construction work – the quality of work needed to implement net zero construction practice. Climate literacy will add to this by helping members understand the ‘why’ behind the work they are increasingly be asked to perform to meet climate objectives in contract specifications and building codes. It provides the ‘big picture’ of the way their work contributes to solving the climate crisis by lowering energy use and GHG emissions. It facilitates understanding the purpose of net zero construction practice, which requires seeing projects as integrated units in which everything must be done properly to succeed. It also strengthens a cultural shift towards systems thinking, teamwork, shared responsibility for outcomes and the corresponding satisfaction that comes with being part of a job well done .

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<sup>44</sup> Orr (1992) advanced an idea of literacy that placed emphasis on the creation of sustainable human communities and called for a fundamental reconstruction of the entire educational system. The ideology of sustainable development, central to Orr’s (1992) conceptualization of environmental/ecological literacy, gained popularity during the mid-1980s, with the convening of the World Commission on Environment and Development (WCED) in 1983 to address growing concerns about the accelerating deterioration of the human environment and natural resources and the consequences of that deterioration for economic and social development. The WCED (renamed the Brundtland Commission) report, *Our Common Future*, was the first genuinely comprehensive survey of the planet’s health, detailing the problems of atmospheric pollution, desertification, and poverty. The report proposed the concept of sustainable development, defined as “...development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987). 14.

<sup>45</sup> Teelucksingh & Zeglen, p. 7

**1. Understands how the sources of energy, working methods and materials used in their particular trade contribute to GHG emissions, and can apply environmental principles to practical workplace situations to reduce energy use and emissions,**

A climate literate workforce is able to distinguish among the various sources of energy, how they are produced and their carbon footprint. This knowledge makes it possible to evaluate the impact of different energy sources used in the construction process and the building and infrastructure it creates. It explains why government policy is promoting the transition from fossil fuels to renewable energy sources such as replacing gas and oil heating plants with electrically powered heat pumps. Climate literacy provides workers with an understanding of the reasons for these changes and the anticipated benefits for society.

The construction process and its outputs of buildings and infrastructure consume energy and generate GHGs at all stages of the building cycle. Climate literacy in the construction sector involves having an awareness of the climate footprint of all these stages, a concept increasingly referred to using the term ‘circular economy’.<sup>46</sup>

This knowledge also clarifies why so much attention is now being paid to the carbon footprint of the materials used in construction. This is reflected in the increased use of mass timber and other naturally sourced inputs whose production does not release significant volumes of carbon. The effort to lower the carbon footprint is also leading to the adoption of many new materials and working practices to which construction workers must adapt.

To meet climate objectives, buildings must be constructed much more precisely and specifications followed more rigorously. This approach requires higher levels of training, and greater care about the quality of the work performed. This, in turn, has significant impacts on how building workers do their jobs.<sup>47</sup> It also provides a strong argument for much greater investment in workforce training and a shift in the industry towards higher qualification standards and working practices that support greater worker agency and responsibility for project outcomes.

Embracing climate literacy offers a means to address present and future challenges facing the building trades, including preparing workers for a low carbon economy. Commercial and residential buildings, taken together, are responsible for about 40% of energy consumption and just under that in GHG emissions in most Western countries.<sup>48 49</sup> Too many buildings are still being constructed that fail to meet low-carbon objectives. These will have to be upgraded to meet climate standards. There is also a very large stock of existing buildings that will need extensive retrofits. Decarbonating our buildings and infrastructure will require enormous new investments.

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<sup>46</sup> Urban Green Council, 2019. Fundamentals of Building Green.

<sup>47</sup> Clarke, Linda and Christopher Winch. (2022). VET for a Greener Construction Sector: Low Road or High Road Approaches to Apprenticeship. In: Apprenticeships for Greener Economies and Societies. European Centre for the Development of Vocational Training. Brussels. [Apprenticeships for greener economies and societies \(westminster.ac.uk\)](https://www.westminster.ac.uk)

<sup>48</sup> IPCC 2022. op. cit.

<sup>49</sup> In Canada, with its mix of renewables, extensive fossil fuel production and energy used in transportation across its large geography, CO2 emissions from buildings are at approximately 17%



It should also create large numbers of good construction jobs.<sup>50</sup> Union contractors and their workers want to be involved in this work, especially considering that governments are committed to the eventual phasing out of jobs in the carbon economy.

One of the most visible impacts of climate change is how it results in more extreme weather events. However, our buildings and infrastructure were built at a time before such events became common and hence are not sufficiently resilient to meet the impacts of violent storms, heat domes, floods, and numerous other climate induced changes. Canada's Climate Science 2050 policy notes that "Extreme weather events can cause severe damage to residential and commercial buildings, as well as to other core public infrastructures (e.g., bridges, roads, wharves, municipal water systems, rail transit.)"<sup>51</sup> It emphasizes the importance of incorporating resiliency into infrastructure design and construction. The resulting changes to building codes and contract specifications are already changing the nature of some components of construction work and will significantly impact the jobs of some construction trades.<sup>52</sup> Climate literacy provides a basis for understanding why extreme weather events are happening more frequently, how this is changing the construction process and the work of those performing it and why these changes are needed.

## **2. Grasps the link between environmental sustainability, social inclusion, equity, and strong labor standards to produce good green jobs and healthy communities,**

The construction industry and its unions have a positive role to play in the shift to net zero. The Rio Earth Summit of 1992 produced the United Nations Framework on Climate Change which recognized the important role unions play in defending workers and how that made unions key players in mobilizing to address climate change. Union members are also community members and many of the public policy changes unions ask for are ones that go beyond what happens at the bargaining table. They focus on having a better society.

One illustration of this is that unions often lobby elected officials to pass policies and legislation such as community benefits agreements. These are designed to ensure that public infrastructure spending supports community development, creates well-paying local jobs, and provides unions with a role in both training and employment, ensuring projects go union. To obtain community support, which is often essential for projects to be approved, contractors and unions often work together to make the argument that the organized labor delivers the best quality work, is an economic engine that aids communities, that unions are recruiting diverse candidates into an apprenticeship or effective vocational training with a strong career path and that unionized construction provides high road jobs that can diminish economic inequality for women, Indigenous people, racialized minorities and others normally excluded from the industry<sup>53</sup>.

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<sup>50</sup> Bridge, T. and Gilbert, R. (2017). Jobs for Tomorrow - Canada's Building Trades and Net Zero Emissions. <https://columbiainstitute.eco/wp-content/uploads/2017/09/Columbia-Jobs-for-Tomorrow-web-revised-Oct-26-2017-dft-1.pdf>.

<sup>51</sup> Environment and Climate Change Canada. (2020) Climate Science 2050: Advancing Science and Knowledge on Climate Change. Ottawa: . p. 16. [Climate Science 2050 - Canada.ca](https://climate-science-2050.ca)

<sup>52</sup> Ibid.

<sup>53</sup> Teelucksingh and Zeglen 2016, Luke, Zabin, Velasco and Collier 2017, Cha and Skinner 2017

Acknowledging the climate crisis, promoting low carbon construction and supporting renewable energy investments can expand public support for building trades' unions, particularly when they signal that they are committed to providing good jobs for women, visible minorities and Indigenous people. These are some of the ways unions can work towards social inclusion and equity.

The Canadian Building Trades Union (CBTU) recognizes the importance of Indigenous participation in its publications and practices, and that more needs to be done to be good allies with First Nations. In "Build Together," CBTU states that Indigenous knowledge tends not to be incorporated in construction projects, but pledges to change that. "As we design a method to reach out to Indigenous Peoples, we know that often they are told their input is important in projects, but their feedback is not sought until well after the development stage. This is not a meaningful method to solicit Indigenous knowledge. Rather than making this error, Build Together is looking to integrate First Nations input right from the beginning, building in collaboration with, and for, Indigenous people."<sup>54</sup>

The concept of what some Indigenous people refer to as planning for the seventh generation is embodied in some versions of building for the future. Aside from the abstract goal of lowering emissions, building trades climate education is informed by the idea of making life better for successive generations of humans and other species that share our planet with us.<sup>55</sup>

### **3. With appropriate training, can make informed and responsible decisions, problem-solve, collaborate with others, and apply knowledge creatively to enhance sustainability in the workplace,**

Climate literacy encourages greater worker involvement in project operations, worker agency, teamwork, and collaboration. It highlights the key issue of inter-occupational awareness, including knowledge of what other trades do and how their work interacts with the work of other trades. This in turn implies an ability to communicate and co-ordinate effectively with others and thus the importance of promoting a climate aware culture in the workplace that facilitates engagement by employers and workers in the task of constructing high performance buildings and infrastructure, as well as an understanding of how construction work and its outcomes affects building users and the broader community. It also emphasizes the importance of

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<sup>54</sup> CBTU 2022, Build Together: Indigenous Peoples of the Building Trades <https://buildingtrades.ca/workforce-dev/build-together-Indigenous-peoples-of-the-building-trades/> See also CBTU, n.d. Building Trades Indigenous Peoples of the Building Trades, Indigenous Allyshop [http://buildingtrades.ca/wp-content/uploads/2022/01/BT-IndigAlly\\_Booklet\\_WebCopy\\_ENG.pdf](http://buildingtrades.ca/wp-content/uploads/2022/01/BT-IndigAlly_Booklet_WebCopy_ENG.pdf)

<sup>55</sup> A California based example of the value of utilizing Indigenous practices is found in the local fire departments who work with the Yurok and other tribes to conduct controlled forest burns. (Buono, P. 9 Nov 2, 2020). "Indigenous tribes in California and other parts of the U.S. have been rekindling the ancient art of controlled burning," The Nature Conservancy. <https://www.nature.org/en-us/magazine/magazine-articles/Indigenous-controlled-burns-california/>

developing appropriate attitudes and responsibility for outcomes, which themselves are necessary for effective collaborative working.<sup>56</sup>

The importance of workplace and organizational education is highlighted by Reis and Ballinger<sup>57</sup> who examined curriculum and delivery developed by Manchester Metropolitan University, in collaboration with the Carbon Literacy Project. They found that: “Reducing emissions relies on every single person in an organization being aware of the carbon impacts of their choices, and feeling motivated and supported to take action,” and “Be able to identify ways that you and your organization can take action to reduce emissions, benefiting from this in the process.” In their words:

“The majority of groups involved in the study, regardless of age or experience, responded most positively to a short introductory review of the science, followed by interactive exploration of local case studies in small groups and consideration of individual options for near future behaviour change. These results reflect wider views within the academic literature which suggest that participatory approaches are most effective ... along with those that provide and engage with local, tangible settings. The most engaging aspect within our study for most individuals was the opportunity to “play” with the evidence they had been presented with, for example, being able to plot a transport route through a local interactive map with flood risk areas highlighted, or exploring how they might retrofit a local existing building to cope with changing climate conditions. Such approaches also enabled the discussion of values alongside ‘scientific facts’ and facilitated the development of critical thinking skills and problem-solving, well recognised important elements of climate change education. However, from our own observations engaging in meaningful discussions about climate change impacts and adaptation, is not feasible or realistic for participants without a sound understanding of the basic science, an acknowledgement of uncertainties associated with it and knowledge of local characteristics.”<sup>58</sup>

Linda Clarke and Christopher Winch argue that effective net zero construction requires a high level of knowledge, skills, and competency. This means supporting policies to upgrade the construction workforce to give its members the tools they require to perform their jobs effectively. They call this approach a ‘high road’ which they contrast with a ‘low road’ approach that ignores the significance of worker knowledge, skills, competency, and attitudes and tries to implement projects with poorly skilled workers because they can be employed cheaply.<sup>59</sup>

#### **4. Recognizes the interconnectedness of all stakeholders during the life of the built environment, as well as those who live and work on the land over space and time.**

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<sup>56</sup> Clarke, Linda, Christopher Winch. (2022). Vocational Education and Training for a Greener Construction Sector: Low Road or High Road Approaches to Apprenticeship? CDEFOP and University of Westminster. <https://www.cedefop.europa.eu/files/Clarke%20Winch-%20Vocational%20education%20and%20training%20in%20construction%20-%20low%20road%20or%20high%20road%20approaches%20to%20apprenticeship.pdf>.

<sup>57</sup> Reis, J., & Ballinger, R. C. (2020). Creating a climate for learning-experiences of educating existing and future decision-makers about climate change. *Marine Policy*, 111. <https://orca.cardiff.ac.uk/id/eprint/119345/1/FINAL%20PAPER%20WITH%20REFS%20Creating%20a%20Climate%20for%20Learning.pdf>

<sup>58</sup> Ibid.

<sup>59</sup> Clarke and Winch. (2022). op. cit.

A climate literate construction worker recognizes that everyone on a construction site has a role to play in achieving net zero construction outcomes. Regardless of their specific trade or occupation, the work they perform is essential for a project to meet its design specifications. This requires an understanding of what others do and a respect for the contribution they make. A positive workplace culture which recognizes this and which incorporates a commitment to achieving high performance outcomes is an essential component of effective green construction practice. But it also requires the development of appropriate attitudes and values that facilitate collaborative working and shared responsibility for outcomes.

Climate literacy highlights the key issue of inter-occupational awareness, including knowledge of what other trades do and how their work interacts with the work of other trades. This in turn fosters the ability to communicate and co-ordinate effectively with others and thus the value and importance of promoting an environment in the workplace that facilitates cooperative engagement by all those involved in a building project.<sup>60</sup>

Climate literacy also includes an understanding of how construction work and its outcomes affects building users, the local community, and the broader society. This means recognizing the larger purpose of work beyond getting a pay cheque.<sup>61</sup> Workers obtain personal satisfaction and a sense of achievement when they know that they are involved in projects that create a healthy and productive environment for those who work and live in the resulting buildings, as well as their contribution to the welfare of the broader community that benefits from the climate, environmental and ecological results of projects.

**5. Is aware that the construction trades and related workers can play a unique role in addressing climate change and promoting healthy and safe energy and building projects that deliver quality work and serve people’s needs,**

Buildings are among the largest contributors to GHG emissions in Canada and internationally, which is why governments are focusing so extensively on reducing energy use and emissions from this sector. In its 2014 report on climate mitigation, the IPCC devoted a major chapter - Chapter 9 - specifically on the role of buildings and construction as contributors to global warming.

“(B)buildings represent a critical piece of a low-carbon future and a global challenge for integration with sustainable development... Buildings embody the biggest unmet need for basic energy services...much existing energy use in buildings in developed countries is very wasteful and inefficient. Existing and future buildings will determine a large proportion of global energy demand<sup>62</sup>

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<sup>60</sup> Clarke, Linda., Gleeson, Colin et. al. (2017). What kind of expertise is needed for low energy construction? *Construction Management and Economics*, 35/3(3), 78–89. <https://doi.org/10.1080/01446193.2016.1248988>

<sup>61</sup> Winch, Christopher. (2000) *Education, Work and Social Capital: Towards a New Conception of Vocational Education*. London: Routledge

<sup>62</sup> IPCC (2014). p. 691.

In Canada, the building and construction sector places third in emissions after fossil fuel production and transportation. In 2019 the sector accounted for 90.7 Mt of Canada’s carbon emissions.<sup>63</sup> In light of the evidence, lowering the country’s energy use and GHG emissions has emerged as an essential component of Canada’s climate policy agenda.<sup>64</sup> Governments at all levels now believe that the construction sector and the buildings and infrastructure it produces can - and should - be a large part of the solution to climate change.

This evidence underscores why workers’ knowledge of the positive climate impact of their work in constructing low carbon buildings and infrastructure is so important. Climate awareness reveals why what they do on the job can have such a positive impact not only on lowering Canada’s climate footprint but also in improving the lives of those who work and live in the construction projects they build. Delivering high performance buildings makes a major contribution to society and improves the lives of those who benefit from it.

In our discussion of a climate literate construction trades’ worker at the beginning of this analysis, we noted that knowledge of climate science and the potential for lowering the carbon footprint of buildings provides the basis for action as well. Knowing what needs to be done - and why - provides a clear rationale, as a responsible worker, to take steps within the scope of the trade to ensure that work achieves climate objectives. Examples of curriculum being used by some construction unions, such as a training guide produced by the Ironworkers, or the GPRO system advocate that the focus of action should be broader than the workplace, encouraging workers to address climate issues in their personal lives, their families and in the wider community.

**6. Has a holistic understanding of buildings, the role of their particular trade and how their activities interact and overlap with those of adjoining trades in producing a zero-carbon/energy environment**

A climate literate trades’ worker understands the way in which science is increasingly shaping the way buildings and infrastructure are constructed. Laura Cole refers to this as ‘green building literacy’ a term that underscores the ability to understand building science and its connection with building designs that address climate change. In her words:

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<sup>63</sup> Environment and Climate Change Canada. (2021). National Inventory Report 1990 – 2019 Greenhouse Gases Sources and Sinks in Canada. <https://www.canada.ca/content/dam/eccc/documents/pdf/cesindicators/ghg-emissions/2021/greenhouse-gas-emissions-en.pdf>; p. 18.

<sup>64</sup> Senate of Canada. (2018). Report of the Standing Senate Committee on Energy, the Environment and Natural Resources. [https://sencanada.ca/en/newsroom/enev-reducing-ghg-canada-buildings/encanada.ca/content/sen/committee/421/ENEV/reports/ENEV\\_Buildings\\_FINAL\\_e.pdf](https://sencanada.ca/en/newsroom/enev-reducing-ghg-canada-buildings/encanada.ca/content/sen/committee/421/ENEV/reports/ENEV_Buildings_FINAL_e.pdf)  
<https://sencanada.ca/en/newsroom/enev-reducing-ghg-canada-buildings/>

Environment and Climate Change Canada. (2020) A Healthy Environment and a Healthy Economy: Canada’s Strengthened Climate Plan to Create Jobs and Support People, Communities, and the planet. <https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview/healthy-environment-healthy-economy.html>

The reason the share of emissions in buildings in Canada is considerably lower than in other developed countries is that Canada is a major producer and exporter of fossil fuels. In addition, Canada’s geography and relatively low population density means that transportation is also a major user of fossil fuels. Absent these factors, the share of GHG emissions from buildings would, arguably, be broadly like that of other developed countries, that is in the range of 30% to 35% and likely on the higher end, given the heating demands of Canada’s relatively cold climate.

“Green building design is thus uniquely positioned at the intersection of a variety of socio-cultural, technological, and ecological themes. However, educators need not expand to dimensions beyond science to engage in green building education. Green building design is fundamentally based on scientific concepts and can be viewed through a purely scientific lens. While the topic of green buildings is malleable to a variety of conceptualizations within the broader ideas of science literacy and environmental literacy, the frameworks introduced here were created with a mind toward the potential for interdisciplinarity.”<sup>65</sup>

Cole’s reference to interdisciplinarity emphasizes the collaborative aspect of climate informed building practice. The successful construction of high-performance buildings requires an understanding of the principles underlying their design and the climate objectives they are intended to achieve. This involves integrating knowledge of science with the capacity to link it with the practical requirements of building construction. On work sites this can also include the social dimension of teamwork, collaboration and working with others to achieve a shared outcome.<sup>66</sup> It is a socio-technical process that links an understanding of why climate and building science are shaping how buildings are constructed with the capacity to see how this relates to what has to happen on the job site to achieve design objectives.

In turn, this knowledge facilitates understanding of how the work of individual trades fits in with that of other trades in achieving the overall objectives of building projects. Knowledge of what other trades do provides the basis for achieving effective collaboration and taking joint responsibility for project outcomes.

### **7. Is able to adapt, adjust and integrate the knowledge, skills, and competences necessary to exercise their particular trade in meeting the requirements of a zero carbon/energy building process.**

Work on construction sites involves continuous problem solving. Every project has unique challenges which require trades’ workers to come up with solutions that work in the actual context in which they are being applied. A construction site is not an assembly line. Having a solid theoretical knowledge of the construction process and, particularly, the work of a trade facilitates effective problem solving when new challenges arise.<sup>67</sup>

The goal of climate literacy incorporates a view that construction workers should have well-rounded, thorough apprenticeship and appropriate subsequent training in low carbon construction

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<sup>65</sup> Cole, Laura. (2019) Green Building Literacy: A Framework for Advancing Green Building Education. International Journal of STEM Education. 6: 18.

<https://stemeducationjournal.springeropen.com/articles/10.1186/s40594-019-0171-6>..See also Cole, Laura. (2013) The Green Building as a Medium for Environmental Education. Michigan Journal of Sustainability. Vol. I, Fall 2013. <https://quod.lib.umich.edu/cgi/p/pod/dod-idx/green-building-as-a-medium-for-environmental-education.pdf?c=mjs;idno=12333712.0001.012;format=pdf>

<sup>66</sup> Winch, Christopher. Dimensions of Expertise : A Conceptual Exploration of Vocational Knowledge, Bloomsbury Publishing Plc, 2012.

<sup>67</sup> Clarke, Linda., Winch, Christopher. et. al. (2013). Trade-based skills versus occupational capacity: the example of bricklaying in Europe. Work, Employment and Society, 27(6), 932–951. <https://doi.org/10.1177/0950017013481639>

principles so that they can successfully apply these principles to the many unforeseen issues that occur on building sites. It also facilitates adaptation to the ongoing introduction of new technologies, construction systems and working methods that are a necessary part of transforming the industry to meet tough climate goals. Understanding the principles underlying work processes facilitates adapting to new applications of these principles. Effective net zero construction requires a highly skilled, flexible workforce that can make competent judgements and exercise their skills responsibly.<sup>68</sup>

A climate aware worker also incorporates knowledge of climate science into the occupational identity of the trade itself. In other words, the importance and value of the trade is linked to the successful integration of climate related knowledge, skills and competencies which enable the worker to practice the trade successfully. Exercising agency and doing a good job is an integral part of occupational identity. Engaging in problem solving and overcoming challenges comes with practicing the trade successfully and which is the source of pride and fulfilment in work.

***ABOUT CIRT:** The Climate and Industry Research Team comprises academic researchers from English Canada, Europe, the United States and Quebec whose expertise in climate science, labour relations, apprenticeship, trades training and a variety of low carbon construction issues, support its mandate under the Building It Green project to provide research on climate literacy in Canada and internationally. Its members are: Pier-Luc Bilodeau, Linda Clarke, John Calvert, Evelyn Dionne, Melahat Sahin-Dikmen, Vivian Price and Christopher Winch.*

***ABOUT Building It Green:** The Building It Green project focuses on bringing together industry best practices from around the world to improve the education and understanding of skilled trades workers related to their role in constructing and maintaining net-zero projects and help Canada meet its climate goals. This project is funded by The Government of Canada's Union Training and Innovation Program (UTIP).*

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<sup>68</sup> Clarke, Linda., Gleeson, Colin et. al. (2017). What kind of expertise is needed for low energy construction? Construction Management and Economics, 35/3(3), 78–89. <https://doi.org/10.1080/01446193.2016.1248988>

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