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

Appendix 10
CIRT 2nd Environmental Scan and Literature Review for CBTU Advisory Committee

Climate and Industry Research Team (CIRT) **March 15**

CIRT Environmental Scan and Literature Review March 15 2022

"The construction industry has a vital role to play in the transformation to a low carbon economy, because investment in housing, buildings and factories and basic infrastructure such as roads, bridges, railways, ports, dams, power stations can reduce CO2 emissions in all sectors of economic activity. Emissions can also be reduced through the construction of more efficient roads, bridges, railroads and rapid transit and harbours to transport people, materials and finished goods." Jobs for Tomorrow: Canada's Building Trades and Net Zero Emissions. Tyee Bridge and Richard Gilbert, 2017.

Background and Purpose

CBTU asked the Climate and Industry Research Team (CIRT) to carry out a literature review and environmental scan to examine climate literacy in the trades. This meant documenting and analysing how climate issues are impacting current apprenticeship programs and upgrade courses for working trades. As part of this process, CIRT has examined trades' training programs in English Canada, the US and Europe reaching out to CBTU's network and expanding it by including other trades training institutions in Europe and the United States. A similar investigation is underway in Quebec. CIRT has also met with government representatives, employers, trade unions and 'green' construction advocacy groups as part of its search.

Context

The most trusted organization of world scientists, the Intergovernmental Panel on Climate Change (IPCC), issued its most recent report in February 2022 stressing the critical need to cut emissions to diminish the worst effects of global warming. Many in the business sector – Investors, financial institutions, employers, building owners - as well as unions, human rights leaders, and governmental entities have become deeply invested in the need for decarbonization. In response to the growing concern about the impact of climate change, governments at all levels are adopting policies designed to reduce GHG emissions and lower energy use. Canada is now committed to reducing GHGs by between 40% and 45% by 2030 and reaching net zero by 2050.

Informed by scientific reports and unmistakable signs of a climate crisis, public policy is driving change in energy production and consumption and introducing fundamental changes in the economy. For the construction sector this means a trajectory of increasingly tight building and energy code requirements designed to ratchet down energy use in the construction process and in the operation of buildings and infrastructure. It also means lowering the carbon footprint of construction inputs and viewing resource use as a 'circular' process that minimizes waste and maximizes reuse. These changes will have a significant - and growing - impact on the way construction is carried out in the future.

While the focus of this report is the construction industry, transitioning to a green economy has broad implications that affect the way all industries respond. The growing conflict in the Ukraine is currently raising questions about how to move away from fossil fuel reliance, yet the need to lower carbon emissions and reduce dependency on fossil fuels is increasing in urgency. The fossil fuel economy permeates throughout society, with impacts that fall disproportionately on the most vulnerable.

Therefore, the transition invokes issues of climate justice. "The United Nations Environment Programme (UNEP) defines a green economy as an economy that addresses a reduction in carbon outputs, while demonstrating resource efficiency and social inclusivity"' (Building Toronto, Teelucksingh & Zeglen, p. 7). At both national and international levels, governments have underscored the need for climate policies to be inclusive of gender, race and ethnicity. The transition should protect the most vulnerable, reduce disparities, increase equality and strive for a just transition to a net zero economy. Inclusivity is also important given labour shortages that can be most effectively addressed by ensuring that the workforce is fully representative of the broader society. Especially as public monies are involved in investing in a green transition, construction leaders must be mindful of the importance of working not only on quality performance but also of integrating practices that move us towards equity.

Low Carbon Construction and Climate Literacy

The research indicates that frequently there is a significant performance gap between design specifications of low carbon buildings and their measured energy use and other anticipated benefits when completed. One of the main reasons for this disparity is inadequate workforce training in low carbon construction practice.
Green construction requires a much higher level of care and attention to detail than traditional construction. Failure to meet design specifications in even one area of a project can compromise the outcome of the whole project. This means understanding how everyone's work contributes to the process and taking responsibility for ensuring that the overall project achieves its intended purpose.

Another issue is the move towards a circular economy which gives conservation and reuse of resources a much higher priority and takes account of the carbon footprints of all inputs. This means a greater focus on local sourcing to reduce the high emissions associated with transporting these materials. This approach differs from current low bid practice in that it considers broader ecological and sustainability issues and calls into question contract tendering regulations that remove the ability of governments to include these environmental factors in their purchasing decisions.

These issues and more lay the foundation for the need to incorporate climate literacy into trades' training. The CIRT team has developed a detailed definition of climate literacy as well as how it applies to the construction industry. 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 that are heating our planet. It recognizes that positive changes in society are required to promote a healthy, sustainable, inclusive and biodiverse planet.

Definition of Climate Literacy

The CIRT team has developed a core definition of climate literacy as well as how it applies to the construction industry. 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 that are heating our planet. It recognizes that positive changes in society are required to promote a healthy, sustainable, inclusive and biodiverse planet. (**Please refer to the complete definition in the Appendix.)**

Updating Education and Training

To accommodate the increasingly tough code requirements now in the policy pipeline, apprenticeship and trades upgrade programs will have to reflect the impact of public policies on the industry, including those concerning equality. This will mean incorporating more climate related content into vocational education and training programs to provide workers with the knowledge, capacity and competences to implement low carbon construction practice safely and effectively. It also means opening up programmes by targeting women, Indigenous groups and other diverse groups in society so providing opportunities to be trained and employed in construction.

CIRT has reviewed the content of various apprenticeship and trades' training programs developed by unions, employers and publicly funded training facilities. The purpose has been to find out what the existing training programs include on climate and energy literacy and how they present this to workers. It found good examples both in North America and Europe of how to make these issues directly relevant to the trades' workforce and their work on building sites.

The next steps in the Building It Green project are to use the environmental and literature scan to construct a climate literacy curriculum for the Canadian Building Trades Union. SkillPlan and CIRT are developing sample curricula based on the information shared by trainers, employers, union leaders, college educators and public agency supervisors of apprenticeship across North America and seven countries in Europe. SkillPlan, SRDC and CIRT are also beginning to generate a plan to assess the curricula for the pilots they will be developing in the near future. This involves an analysis of how curricula are developed, disseminated and delivered among those interviewed, with recommendations that may be applicable to multiple countries. How the curricula will be used will reflect pedagogical approaches and the interplay of interests of unions, employers, communities and policy makers.

The changes required to enable the workforce to respond effectively to climate change are not primarily ones involving acquiring new technical skills, important as these can be for some trades. Most knowledge imparted and skills taught in the Red Seal program are those that the trades need for effective low carbon construction. Of course, they can be strengthened in areas such as understanding building science or buildings as integrated systems. But it is the cognitive and attitudinal aspects, including communication, that are most needed now. Apprentices also require an understanding of how climate change is impacting each area of the building industry, and, more specifically, the work they perform, how to communicate this, including to clients, and how to work together with other trades and others on building sites . The interrelatedness of everyone engaged with a low carbon construction project means that tradespersons need to be able to communicate their perspective and experience and participate in every stage of the

construction process.

Recommendations:

The environmental scan and literature review indicates that to be successful, low carbon construction workers need to:

- Understand how climate change is impacting nature and society globally
- Recognize that the shift to a low-carbon economy does not just entail technological change but is grounded in a shift to a more inclusive society
- Identify how climate change is affecting the construction industry and how the industry is affecting climate change
- Have a deeper knowledge of the principles of building science,
- Be aware of what other trades do and how each trade fits with the others
- Demonstrate the ability to communicate and collaborate effectively with other construction occupations/personnel, clients and end users
- Exercise a commitment to teamwork on site
- Develop an understanding of buildings as a system.
- Have a holistic understanding of building production as a social as well as a technical process.
- Adopting a systems approach to the way construction is organized
- Understand the impact of building and construction on users and communities
- Learn how sustainable construction can improve population health and address inequality
- Understand that all work on a construction site affects carbon emissions
- See the union, its members, and workers in general as critical actors in shaping the future

Preliminary Findings Underscoring the Recommendations Stated Above

A key insight from the literature review and the environmental scan is that low carbon construction requires a higher level of knowledge, competency and skills to be executed effectively. Work must be much more precise and details executed more carefully. Trainers have reported that workers need to know how failing to meet standards of work is not just an issue of their work but can prejudice the impact of the overall project. Trades also need to understand why higher standards are required, not just how to carry out the tasks involved. As one trades' instructor insightfully commented: "We are teaching the how, but not the why." Informed by awareness of how their work fits in with the overall project, tradespeople may develop a stronger sense of responsibility for its success. Pride in their work is already a motivator; pride in making the built environment more sustainable would contribute to better project performance. Pride can be reinforced by the fact that high performance buildings have significant health benefits for those working and living in them. In producing low carbon buildings, construction workers are making life better for members of their communities.

Role of Unions

A clear and strong message from the interviews conducted so far is that trade unions across the jurisdictions covered by this research are reporting increasing interest from their members. There is a cross-generational concern about what life is going to be like in the future. The younger generation has more exposure to climate education and is more open to asking questions and wants to be prepared for a job that contributes to a healthier climate. They recognise the significance of engaging in climate action, of being part of the green transition in the built environment. Unions recognise that embedding climate literacy, as distinct from the narrower energy literacy or energy efficiency, in the education and training of the construction workforce is key to enhancing workers' awareness, understanding and capacity to take action, to become, in the words of a union officer from Denmark, "climate agents".

Climate literacy in the Curriculum

Initial review of the selected training programmes suggests that, whilst energy literacy is part of the curriculum, particularly for electricians and plumbers (as the installation of renewable energy systems fall within their remit), climate literacy is either entirely missing or it receives little mention as we have noted in our review of the Canadian Red Seal Standards. There are differences between trades in terms of the extent to which apprentices are exposed to any climate or energy efficiency related knowledge. And what training is provided tends to be technology focused, rather than aiming to facilitate an understanding of both how the production of buildings needs to change fundamentally and the implications of climate adaptation as a process, involving social and economic measures.

What is also important to point out is that all stakeholders, including trade unions, employer representatives, and teachers/instructors, identify this lack of understanding as a major gap and call for the enhancement of vocational education and training to include broader and deeper knowledge and understanding of climate change. Several interviewees highlighted the lack of connection between learning to install, for example, a heat pump, and the bigger purpose of climate adaptation this serves. Others emphasised the significance of enhanced education and training for developing agency, and therefore active engagement in climate action beyond the workplace, for example by participating in initiatives led by municipalities or implementing changes in their own personal lives. Enhanced climate agency is, at the same time, seen as necessary for workers to be able to recognise and to have the ability and the confidence to take advantage of the opportunities arising in the green transition. Even in relation to the installation of renewable energy systems, it is suggested that, as new technological systems emerge all the time, a broad, theoretical and technical education becomes more important to ensure that workers have the capacity to be able to adapt to new technologies.

Stakeholder collaboration

Our early analysis also shows that there is a big step between recognising the significance and value of embedding climate literacy in the education and training of trades, and actual implementation. Reviewing and upgrading established education and training programmes takes a long time and involves negotiations between many stakeholders. Evidence from good practice cases highlight the role of government involvement and support, both by creating a conducive policy environment through climate and energy strategies, and endorsing and

financing the efforts to upgrade existing training programmes and make them more inclusive. The importance of collaboration between unions, employers and educationalists is an equally clear message.

Some unions in North America have already successfully worked with employers and policy makers to enact legislation funnelling money into projects that hire union labour to upgrade energy efficiency in schools, committing also to recruit and train members from marginalized groups. The Illinois Climate and Equitable Jobs Act passed in 2021 is one example of this development.

A cautionary note is that it is important to ensure that curriculum upgrades are as future proof as possible. Countries where energy efficiency related units were added to existing training programmes without addressing the underpinning environmental rationale are now looking to fill this gap. Another issue highlighted by interviewees relates to the confusion that results from lack of standardisation; workers, employers and the public need to have confidence that the workforce has the competence to build/renovate to the new standards in building regulations.

Training and Education as Part of Industry Transformation

We recognize that creating a more climate literate workforce is something that cannot be done by the education and training system alone. It needs the support of the entire construction industry. Building work must be organized to integrate low carbon principles into its operations. Those commissioning buildings must require high performance standards in the specifications and the implementation of these standards must be controlled through rigorous inspection (lack of control has been identified by some interviewees as a serious impediment to change.) Quality must be emphasized and tenders must avoid privileging low bid, minimum standard work (e.g. policies of sustainable procurement). Measuring energy and carbon performance must become standard practice. A common refrain from training providers is that their efforts to enhance education and training are undermined by lack of 'demand' for better equipped and qualified workers. Interviewees suggest that this makes it very difficult to persuade those already in the sector to undertake further training. More broadly, the overall working climate on building sites must support low energy construction practices. The vocational education and training system cannot do all these things or even a large part of them. But it can play a key role in ensuring that workers are fully prepared for their role in the future low carbon construction system. Our environmental scan revealed that many union training centres have incorporated various forms of climate and green skill literacy at the pre-apprenticeship, apprentice, journeyperson and trainer levels with examples from the plumbers and pipefitters, insulators sheet-metal workers, iron workers, electricians, operating engineers and labourers.

Readiness to change, to incorporate new practices, and to embrace new sets of social relations, including teamwork, thus become major imperatives, including for vocational education and training programmes. A successful green construction sector cannot be achieved through business as usual or the traditional 'like' recruitment of 'like'. It means opening up the industry especially to women, indigenous people and others who, historically, have been under-represented. Construction may still have jobs that require physical strength, but it is no longer simply a macho industry associated with dirty, manual, heavy work, It is also in the process of transformation into a highly qualified, inclusive and technologically advanced eco-sector. Such

a cultural change could also help with the attraction and retention of the workforce in an industry impacted by a recurring labour shortage and the vocational education and training system, its curricula, occupational profiles, qualifications and not least apprenticeships need to reflect this.

There have been significant efforts to weave climate issues into the apprenticeship and trades' upgrade programs in both Europe and North America. In the European Union, this has been most extensively documented by the Build Up Skills program. The EU funded its member countries to identify the changes needed in their training systems to enable the construction workforce to implement low carbon construction effectively. It has triggered significant changes in the curricula of member countries over the past decade. Training courses provide the climate rationale for the EU's energy and GHG targets and the corresponding tightening of national building codes, which apprentices and working trades are being required to implement. They link EU policy on climate issues with how construction work is being reorganized to achieve net zero outcomes.

In North America, several unions have developed training modules on climate change, sustainability and energy conservation topics. However, much of this development has been done in isolation so the material has not been widely shared, even though it is being used in several apprenticeship and trades' upgrades programs. Perhaps the most well-known of these initiatives has been the US Urban Green suite of courses promoted under the GPRO label. A number of Canadian and US unions use its training modules to introduce climate issues to their members. Both the US and Canada Green Building Council have worked with unions in delivering training for the construction workforce. Some union initiatives also link pre-apprenticeship programs in secondary schools with a pathway into trades apprenticeship in which climate and environmental awareness are key parts of the curriculum. As noted, a more thorough analysis of courses in circulation and the development of curricula for the CBTU is underway.

The importance of the Construction Industry and Its Workforce in Addressing Climate Change

The building and construction sector is absolutely critical to achieving Canada's policies to mitigate and adapt to climate change, given its large share of GHG emissions and its reach into so many parts of the economy. The training system for construction workers provides them with the basic skills needed to implement successful low carbon construction. The system is quite capable of incorporating the changes noted above into its curricula to prepare the workforce for what will be needed in the future. Unions can play a key role in this process by making sure that their apprentices and journey workers have the opportunity to acquire the competencies, knowledge and know-how required to deliver quality low carbon construction projects.

The direction of public policy is clear: governments are committed to making major changes in the way construction is delivered so that the industry can reach their demanding climate targets. The urgency of addressing climate change will become more pressing with each passing year and this will be reflected in even tougher standards and regulations. As the mainstream industry has already demonstrated, employers will only deliver low carbon construction when they believe there is a demand for it from those commissioning construction services. They will support

investment in training only when they see an immediate return on it. However, if the industry is going to meet climate expectations, the training system cannot wait until the demand comes from employers. In pressing to include climate literacy in the curriculum, unions can ensure that their members are ready when that demand comes and that their members will be able to deliver quality, high performance building outcomes. This requires a proactive, not reactive approach to change. But it also gives unions a unique opportunity to become climate champions and position themselves on the leading edge of change in the industry.

Appendices

1. CIRT Interim Report: English Canada Team Members October 14, 2021
2. CIRT Interim Report: European Team December 31, 2021
3. CIRT Interim Report: US Team December31, 2021 (revised)
4. Concept Brief: On the Definition of Climate Change
5. Research Paper: How is Low Carbon Construction Different From Conventional Construction?
6. Research Paper: The Critical Role of the Construction Trades in Addressing Climate Change
7. Research Paper: Climate Change and Canada's Red Seal Standards
8. Bibliography

Appendix 1

Climate and Industry Research Team
Initial Interview Summary
October 13th, 2021

"We are Teaching the How, But Not the Why" Comment from a trades' training instructor:

Executive Summary

This environmental scan is to provide CBTU with a preliminary analysis of the findings of the interviews we have conducted in the initial stages of the project. Thus far we have done 14 interviews with trades' trainers that CBTU recommended. The process has been very intense, but also very informative, and we are still digesting what we have found.

The Interviews have included trades' instructors and directors of international, national, provincial and regional training programs. Thus far we have covered most, but not all, CBTU member unions. Two of the interviews have included directors of training programs based in the US. But they were reasonably familiar with their unions' training programs in Canada. All interviewees were experienced instructors with most having had decades of training under their belts. All have responsibility for overseeing individual training programs and/or supervising other trainers in their unions. Some of the interviewees were based in union owned and managed systems while other were employed in training schools jointly trusteed with employers, normally financed through collective agreement deductions.

The purpose of carrying out an environmental scan is to find out what is actually taking place in the training programs being delivered by various trades training programs. We formulated a set of questions covering areas that we thought were relevant to assessing the extent to which programs included instructional content related to climate literacy. Our questionnaire contained a broad range of questions. It was designed to cover all trades and, consequently, contained questions more relevant to some trades than others. But we tried to ensure that each key area was investigated during the interviews. In addition, we learned things we did not anticipate in our original questionnaire, and we have incorporated this information into this report.

Before the interviews we sent the trades trainers a one-page overview outlining the issues we planned to cover indicating that our focus was to try to identify the extent to which the training programs promoted 'climate literacy,' broadly defined for apprentices, journey workers and, in some cases, in pre-apprentice programs.

What became clear from the interviews was that the term climate literacy was not customarily used to describe curriculum content that focused on environmental and energy-related issues. Rather instructors used a variety of different terms such as: 'green', 'sustainability', 'environmental responsibility', 'energy saving', 'conservation', 'LEED', 'Energy Star', 'Net

Zero' and similar terminology. However, we felt the interviewees understood what we were getting at in using concept of climate literacy.

At the same time, it was clear that many of the concepts and trade skills instructors were teaching included some of the essential components of developing a climate literate workforce. It is just that they were not labelling many components of the training, including skill sets and on-the-job practices using the terminology of climate literacy.

As we would expect, there were significant differences in the training programs of the unions themselves, reflecting the different work of their respective trades, the interests and priorities of the training facilities, size, geographic location and, in some cases, the differences between the Canadian and US contexts. This was reflected in the content of the answers. We also found that some of the most interesting curriculum material had been developed in the US by the international unions which they were sharing with training programs run by their Canadian affiliates.

Most programs did not have specific course content dealing explicitly with climate related issues. However, the interviews revealed many training programs included instruction on specific skills, working practices and technologies whose purpose is to reduce energy consumption in buildings, on construction sites, in the selection and use of materials and the management of waste and recycling. These included, for example, instruction in installing ground source heat pumps, geothermal systems, hydronics, solar water, solar electrical, LED lighting, HVAC, mechanical insulation, water conservation, and so forth. Some emphasized environmentally sustainable practices such as soil conservation, drainage and good site preparation or the need to shift to less polluting and energy intensive equipment. While the emphasis on energy reduction practices was primarily about cutting costs, training programs also contained material that informed apprentices that reducing energy use was good for the environment and the climate.

Several programs also explicitly dealt with climate change, in pre-apprentice, apprentice and skilled trades upgrading. One contained detailed course material outlining the principles of climate science and the direct contribution of the construction industry in meeting Canada's climate objectives. Its purpose was also to stimulate a broader conversation among apprentices about their role – and the role of their trade - in meeting the climate crisis. Two programs were incorporating climate focused content from the US Urban Green Council's GPRO program. Another program included courses that contained extensive discussions about energy and climate change. We have provided further details on these programs and courses later in this document.

As we dug a bit deeper, we found that while concepts such as reducing energy use, conserving water, improving the efficiency of mechanical systems and so forth were being taught, they were

not normally being ‘framed’ as solutions to the climate crisis. Nor did most programs say much about the positive contribution that the building sector can make to reducing GHG emissions and lowering Canada’s carbon footprint. But lowering the energy use of buildings and the carbon footprint of the construction industry are widely seen as among the most critical elements in programs addressing climate change. The industry will be called on to play a critical role on this issue in the future. We saw this as a gap in the Red Seal curriculum for most trades. Similarly, we thought that there could have been a clearer link between learning specific skills and the value of these skills in addressing climate change.

While there is a tendency to see opportunities for the construction industry to address climate change primarily through making buildings more energy and water efficient, the industry also can have a major positive impact through producing needed infrastructure. It is the construction industry that builds our water and sewer systems, our electrical grids, our subway and public transit services, our transportation and communications networks and a wide range of other infrastructure that Canada needs to adapt to our changing climate. It also is responsible for the work needed to make our manufacturing and industrial plants more energy efficient. While it is easy to overlook the role of the trades that build this infrastructure, their work is no less important than that of some of the more easily identifiable ‘green’ building projects.

Our interviewees noted that a major barrier to expanding the ability of the training programs to address climate literacy was the lack of demand for low carbon construction in the specifications of those commissioning projects. If purchasers of building services and their architects and engineers did not require projects to meet stringent environmental and energy standards, the scope for trades’ workers to implement low carbon construction was correspondingly limited. Trades’ training schools were not in control of what the industry demanded. They had to respond to what contractors and those paying for construction projects wanted. And this, in turn, affected what instructors felt they could include in their curriculum. What they could do was to prepare their students for changes in the industry which will be occurring in the coming years. Because many of today’s apprentices will become supervisors and project managers in the future, providing a background in climate science as well as a solid grounding in building science can also have long term benefit for the success of the industry on this issue.

Another barrier was the lack of references to climate change in the Red Seal Standards which form the basis for the curriculum being used by training centres across the country. Interviewees were generally supportive of the Red Seal system. But they also noted some of its limitations, including the relatively slow pace of modernizing the Standards in the context of a rapidly changing industry in which new technologies and working practices were being introduced constantly. Perhaps more relevant to this project, we found that those training programs that included material on climate change did so outside the scope of the formal Red Seal program,

indicating to us that there is a need for a review of the extent to which the Red Seal Standards should include material on climate related issues in its curriculum guidelines.

Interviewees volunteered a great deal of information about their pre-apprenticeship, apprenticeship and trades' upgrading programs. Where their programs addressed issues related to climate literacy, they highlighted the content of the relevant curricula and shared some of it with us. Overall, we felt that the training instructors felt it was a topic that merited more attention and were clearly interested in exploring this issue further. Some expressed the view that addressing it was overdue, given how workers in the industry have been affected by increasingly intense climate related incidents in recent years, such as dramatic heat waves, hurricanes, floods and so forth. While there were differences in how – and how quickly – different interviewees felt the issue should be addressed, this was more a question of how best to proceed rather than reservations about the need to address climate issues in the training programs in the first place.

Every person we interviewed went out of the way to help us with our research. They made time in their busy schedules to meet with us on Zoom. All offered to provide us with further information if we needed to follow up on issues they discussed in their interviews. In addition, many agreed to send us more details of their training programs, including sections of their curricula relevant to our investigation. We have received some of this already and have found it extremely useful and plan to use it in to inform our work in this project in the coming months.

In the following pages we have set out our initial findings from the interviews we have conducted so far. Given the nature of the topic, inevitably there is a bit of overlap among the issues we have covered. Consequently, there is a certain amount of repetition in some of the accounts we have given in the different topic areas. But this has been to ensure we did not overlook information relevant to these various topics. We have deliberately not included references to the very large volume of academic literature on climate change and the more specialized research on role of the construction sector in mitigating and adapting to climate change. We will be addressing this in the literature review which we will be providing to this project in the coming months.

Finally, we should note that this account of our interview findings does not include information from the province of Quebec. We plan to carry out a similar set of interviews there in due course, as we want to ensure that a Quebec perspective fully informs our analysis. We are in the process of organizing a parallel set of interviews, largely in French, which will be rolling out in the coming months. Filling this gap is now a high priority for our research team.

Summary of Key Interview Findings

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1. Role of Red Seal Standards and Provincial Curricula in Determining the Climate Content of Apprenticeship Programs

An ongoing theme of the interviews was the extent to which the curriculum is determined by the current Red Seal Standards. As CBTU members know, these Standards establish the core skills apprentices must master to get their interprovincial trades qualification. This, in turn, requires trades trainers to focus their apprenticeship programs on developing the knowledge and skills to enable apprentices to pass their Red Seal exam. Provincial curricula directives are largely based on the Red Seal Standards, although provinces may add to, or modify, what is included in the Red Seal requirements. The combination of provincial curriculum guidelines and Red Seal Standards shape what is included in the curriculum of trades' training programs across the country.

The benefits of having a national system based on Red Seal standards was generally supported by interviewees because it enables qualifying journey workers to have their credentials accepted in different provinces. Although not fully implemented in some trades and in some regions, in principle, standardization of curriculum means apprentices receive broadly the same course content at each level of their program, regardless of where they do their training. This enables them to transfer credits from one province to another during their apprenticeship. It ensures that Red Seal qualified journey workers have a similar set of skills for the practice of their trade when they graduate. And it provides for consistency in what is being taught in training institutions in the provinces. Several of the interviewees indicated that they had participated in committees involved in revising the Red Seal requirements for their specific trades, so they have had input into the process.

However, we heard a number of criticisms of the Red Seal system from the trainers we interviewed. One was how difficult it was to modernize, or upgrade, the content of the Red Seal requirements due to the lengthy time between each revision of the Standards. This is often 4 or 5 years and, in some cases, longer. Given the pace of change in the industry, this meant that skills needed for new technologies, or major changes in construction practices, were not being introduced in a manner that paralleled what was actually happening on job sites. This delay is also significant from the perspective of attempting to introduce any material that discusses climate literacy in the curricula.

A second concern of instructors was that some of the skill requirements were simply outdated. Apprentices were expected to learn skills, such as how to read an oscilloscope, that were no longer being used in the industry and which they would never be likely to need on the job. Several felt the curriculum was using valuable classroom time to teach irrelevant requirements.

Another issue was that some curriculum content covered skills that almost all apprentices would have already learned, either in high school computer programs, or through their involvement with laptops, home computers, IPads, cell phones and so forth. One instructor commented that allocating time to teach skills such as how to use word processing software ignored the reality that apprentices already had these skills coming into his program and, consequently, did not see the value of devoting class time to this issue.

With respect to climate literacy, the Red Seal Standards, as posted in the pdf files on its web site, (and the corresponding provincial curriculum based on these Standards) contains almost no information about climate issues or the role of the trades in meeting Canada's climate change commitments. (We have shared a separate short paper on this issue with CBTU which is posted on in its collection of materials for this project on its web site.) Of course, as we note further on, the Red Seal Standards do cover most of the skills required to work on low carbon construction projects or implement LEED, R-2000, Passive House or other third-party standards designed to reduce energy consumption and promote environmental sustainability. And we are aware that many instructors do speak about climate issues in the programs they teach and in demonstrating specific skills. But in doing so, they are going beyond the Red Seal requirements.

Moreover, while the Red Seal Standards cover almost all the skills needed for implementing low carbon construction. These skills are not presented as a way that the building trades can have a positive impact in addressing climate change. Consequently, while the skills being taught are critical to implementing effective low carbon construction, discussion about how they contribute to lowering GHG emissions or meeting Canada's climate commitments is not currently included in the detailed descriptions of how to perform these skills. As one interviewee insightfully said: "We are teaching apprentices the 'how' but not the 'why'.

Several interviewees noted that provincial trades' curriculum requirements were sometimes not properly aligned with the Red Seal Standards. This meant that some of the provincial course material was not directly applicable to helping apprentices pass their Red Seal exams. Although not a climate-related issue, it underscored some of the problems instructors had with the system.

One instructor noted that the absence of climate curriculum material in the Red Seal Standards left him in an awkward position because he felt he did not have relevant climate literacy content to use in his training program. As someone without a scientific background he felt uncomfortable raising the issue with apprentices because this was not his area of expertise. He emphasized that it would have been helpful to have had curricula covering climate issues provided to him so that he would be able to introduce the subject into the classroom without feeling that he was 'out of his depth'

Another training director took the view that it was critically important for apprentices to master the Red Seal Standards first, before attempting to add other components. He felt additional education and training on climate issues should best occur through specialized modules or short

courses after students had completed their apprenticeship and began to work as fully qualified journey persons. For him, amending the Red Seal Standards to include issues like climate literacy was a challenging task that could take years to achieve, largely for reasons noted above. So it was best to focus on skills training.

However, other instructors said the opposite. They felt that what was happening to the climate was affecting the work of their trade and should be covered in the material provided to apprentices. They also felt that that there was considerable room to introduce climate literacy if some of the outdated requirements were deleted as part of a process of revising the overall Red Seal requirement for each trade. They were also concerned to give apprentices an understanding of the future challenges the industry would be facing. One indicated he wanted to be able to show his grandchildren what he had done to secure their future.

A constant theme of our interviews was the need for the training programs to focus more on 'soft skills'. These involve learning how to communicate effectively with all those involved in carrying out the work on a building site including architects, engineers and, most importantly, other trades. Instructors felt the Red Seal Standards could do much more to emphasize the importance of these 'soft skills' and provide illustrations of how instruction about them can be integrated into the curriculum.

While the above observations have focused on the Red Seal Standards, similar comments applied to the detailed curricula provincial governments provided to trades' training schools.

Interestingly, we found that some of the most innovative curriculum content on environmental sustainability and climate change has been developed in pre-apprenticeship programs and journey worker upgrade modules. We believe the reason is that these programs are not subject to the same constraints as the Red Seal curriculum, so some instructors have had the scope to develop course content that specifically deals with these issues.

Given the concerns that many instructors voiced about the limitations of the current Red Seal Standards, making changes to them to make them more relevant to today's construction industry and including information about the role of the construction trades in addressing some of our climate issues would seem to be an important issue to raise in the revisions periodically being made to the Red Seal Standards. Of course, this requires cooperation between the 10 provincial Directors of Apprenticeship, the Federal Government, the industry and the unions. What is needed, perhaps, is a much greater sense of urgency in this process, both to recognize the importance of keeping on top of the increasingly rapid technological and organizational changes

taking place in the industry and to ensure that the Standards provide apprentices with a basic understanding of how climate change is going to affect the industry and their trade in the coming years.

The Red Seal is a Canadian system. So, our interviews with US based interviewees did not address the issue because the certification, or accreditation systems for US skilled trades varies somewhat from the Canadian practice. Consequently, we are not aware of the extent to which some of the points discussed above on the Red Seal system would apply to US training programs.

2. Instructor Flexibility in Designing the Curriculum

As noted in the preceding section, the Red Seal Standards place constraints on the ability of instructors to shape their curricula and are largely silent on climate change. This raises the issue of whether there is scope to include information about this issue beyond what is in the current Red Seal Standards. The interviews revealed that there were divergent views about the extent to which instructors could – or should - modify the curricula. Some trainers felt that they had to teach only what was in the Red Seal Standards (and corresponding provincial requirements), feeling that they had very little control over the course content of their programs. Helping students passing their exams was the priority.

However, others felt that they had considerable flexibility as long as they covered the basic Red Seal skill requirements. In fact, most instructors indicated that they had modified the content of their training programs to include what they felt apprentices needed to know when they went on building sites. Given Canada's geography, it is not surprising that many instructors customarily amended parts of the curricula, giving more emphasis to some skills than others. This reflected the reality that job requirements vary on a regional basis and according to the industrial mix in each province. Some of the skills needed in the maritime climate of BC for building in a coastal rainforest, were different from skills needed in much drier and colder central Canada. Skills relevant to shipbuilding would not be all that relevant in Saskatchewan. Skills needed in major resource projects would be more relevant in Alberta than PEI. Thus, a number of instructors indicated that, as a practical matter, they deliberately gave more time to focus on Red Seal skills needed in the key industries in their region, while giving less attention to skills which would not be in high demand. One instructor said that they 'borrowed time' from teaching one skill so they could give more time to another they knew was important in their area. This did not mean they were ignoring the Red Seal requirements. They just applied them flexibly.

Beyond this, a number of interviewees said that where there were obvious gaps in the Red Seal Standard skill requirements, they deliberately modified parts of the curriculum to ensure that apprentices were receiving training that corresponded to current working practices in the

industry. They believed that apprentices should be learning skills that would be needed in their everyday work on the job – skills that reflected the demands of a rapidly changing industry. Where the Red Seal Standards did not cover relevant knowledge, or skills, instructors simply added them to the curriculum. They did not want to see their apprentices going to work unprepared for the demands they knew they would face on the job. So, in practice, trades' trainers already exercise varying amounts of discretion over how they apply the Red Seal requirements, indicating there is scope even within the current Red Seal for including climate material in the curriculum. However, the extent of the scope varies from trade to trade.

Turning to the issue of climate related material currently being included by some instructors, most interviewees indicated that they cover building standards such as LEED, Energy Star, ASHRAE, R-2000 or Passive House. But as noted earlier, most did not connect these voluntary building standards to climate change, teaching them as systems that apprentices needed to learn because parts of the industry were adopting them. However, several trades' training directors indicated that they had incorporated a significant climate awareness or climate literacy component into their curricula. the details of which are included in the next section of this report.

3. Inclusion of Climate Science Content in Curriculum

As we noted in our introduction, there are few explicit references to climate science in the curriculum of the programs we examined. While apprentices are learning important skills necessary to implement low carbon construction, this material is not presented to them from the perspective of mitigating or adapting to climate challenge. From one perspective, this gap in the training programs is a missed opportunity to inform apprentices that their work and the work of their trade can make a very great contribution to meeting the climate challenge. It also means they are not being given an opportunity to discuss how the emerging climate crisis will be affecting the industry that will employ them in the future.

One interviewee indicated that he was using Green Building Council GPRO modules in the curriculum he was providing to his trades' instructors for use in their apprenticeship programs. GPRO is perhaps the most well-known climate related training program in North America. It has been used extensively by some building trades unions in the US where it was originally developed. As part of its discussion of green construction methods, GPRO includes material on climate change and its impact on the construction industry. Some of its curriculum is in the form of short, general courses designed to provide an overview of how climate change is affecting the construction industry in general. But it also has developed a number of trade specific courses to enable practicing journey workers to learn concepts and skills that they can immediately apply in their current jobs. (We provide more information on GPRO in the next section of this report)

Another program that explicitly addressed climate issues was developed for a pre-apprenticeship program delivered to Grade 12 students as part of the union's efforts to attract more young people into the trade. The material was subsequently added to the first year of the union's apprenticeship program as well. The instructor had put together an 11-module textbook and made it available on-line for the students, incorporating interactive teaching methods. The modules explained the greenhouse effect and the science of GHG emissions, discussed impacts of various kinds of energy (wind, solar, hydro, geothermal, nuclear and various fossil fuels) reviewed the development and expansion of renewable electricity globally, and in Canada, and explained the history of the development of photovoltaics. It discussed the impacts of various energy sources on the environment and on carbon emissions. It also examined a range of other environmental issues such as pollution and resource depletion. The text was thorough and well researched, covering a broad range of climate and environmental issues, including their economic, social and workplace implications.

The director of the training school had decided that the union should develop this course content because there was nothing comparable available in the Red Seal or elsewhere. It reflected his view that it was important to expose the students to information about climate issues to give them an understanding of the future impacts on the construction industry and their trade. Apprentices needed to grasp the broader changes in the environment and the climate so that they would be prepared to deal with these changes during their careers.

Turning to a third training program that explicitly included climate literacy material, the training director of a national US union noted that it had developed five courses varying from 4 days to 20 days of instruction dealing with the principles of green construction and their application to specific aspects of the work of the trades his union covered. Successful trainees of this program could add a 'Green Advantage' certification to their trades' qualification. The package of training material included an introductory course on the principles of green construction and a more advanced course to expand on concepts and information presented in the initial course. It also dealt with issues of climate justice as essential to a 'green' transition of the US economy. In addition, there were three separate courses dealing with specific components of three sub trades represented by the union. Developed about a decade ago with funding from the US Federal Government, these courses were available for the union's apprentices to download and use to study for their Green Advantage certification.

To assist our research, another CBTU member union had shared with us copies of two of its 'green' construction handbooks which it had developed for its apprenticeship training program. The manual outlined why green construction was important for its trade from a technical perspective and from the perspective of current jobs and future employment. It argued that the union needed to address the problem of climate change in its training program and referenced

several well-known scientific studies, such as those of the Intergovernmental Panel on Climate Change as important sources for background information.

The manuals noted that the trade was involved both in infrastructure that promoted green energy and infrastructure that supported construction of green buildings. The manuals referenced and explained the approach to greening the industry being promoted by the Green Building Council and emphasized that acquiring knowledge and skills for low carbon construction increased the value of the work of members of the trade for contractors and the employability of union members. It pointed out that there were five areas of construction that should be considered in evaluating whether a project was green. These were site planning, use of materials and resources, water use, energy use and, where relevant, the resulting indoor air quality. It also provided apprentices with an overview of the LEED system and encouraged them to become accredited. Finally, it suggested that apprentices should make use of the environmental and energy concepts included in the handbooks in how they managed their own lives.

In our interviews we noted that the scope for including climate literacy material in training programs varies significantly among the trades. Arguably, it is somewhat easier for trades installing hydronics, heat pumps, HVAC systems, mechanical insulation, solar water, solar electric, LEED buildings, vehicle charging stations and so forth to discuss the broader climate and energy conservation rationale for these systems and technologies. By the nature of their work, other trades may not appear to be obviously involved in areas which are as directly linked to climate issues, so the opportunity to discuss climate issues may appear less obvious. However, as we noted in he introduction, all trades contribute to the industry's output in their different ways. And the work of all trades is essential for the industry, as a whole, to move towards low carbon production outcomes. This broader perspective needs to be considered in thinking about how climate issues can be incorporated into trades' training for all trades.

We are aware that the question of how information about climate change should be included in the curriculum of the trades' training system is not for us to decide in this report. But it is an issue that we think will increasingly be on the agenda in the future considering what climate scientists are saying about the impact of GHG emissions on global temperatures in the coming years.

4. The GPRO Model for Introducing Climate Literacy into the Training System

We noted earlier that several instructors said that they had been using GPRO. This is an approach to environmental and climate awareness that is closely aligned with this project's focus on climate literacy. GPRO originated in New York as an initiative by the Urban Green Council. It has been adopted by a number of construction union training organizations across North

America. It is supported by the US Green Building Council and its Canadian counterpart, the Canada Green Building Council.

GPRO explicitly discusses the relationship between buildings and climate change and provides students with an understanding of the basic elements of high performing construction practices that reduce energy use and GHG emissions. GPRO offers a wide range of courses. Some are targeted at the broader construction industry, including contractors, owners, project managers, architects and engineers. But others are focused on providing training for the trades. The courses are modular, lasting from several hours to several weeks and designed to enable workers to upgrade their knowledge and skills associated with low carbon construction.

GPRO emphasizes a 'whole building approach' that involves co-ordination among all those working on building sites, including architects, engineers, planners, contractors and trades' workers. It also emphasizes the need for effective communication among all those involved in sustainable construction processes, including subcontractors and the trades they employ. It stresses system thinking in which all aspects of a building project are conceived of as an integrated whole rather than a bundle of separate components.

GPRO teaching methodology includes in-classroom training, on-line homework and on-site exposure where feasible. GPRO awards certificates for some of its more rigorous courses, based on successfully passing exams. Trades who complete their courses can add them to their resumes. GPRO has developed specific upgrade courses for plumbers, electricians and several other trades. These offer training in some of the latest green technologies. However, their focus is also practical: to enable workers to apply what they have learned in GPRO courses to their construction work immediately, so the training emphasizes providing 'hands on' skills applications.

Another important aspect of GPRO is its focus on bringing everyone involved in a project in at the beginning. It advocates bringing the skilled trades into the construction process at the design stage as members of the project team to ensure their knowledge of building practice is incorporated into how construction projects are organized. This is consistent with some of the research on low carbon construction which emphasizes the importance of teamwork and shared responsibility for the outcome of projects.

One Canadian training director indicated that his union had experimented with GPRO curricula in a limited way with mixed results. However, another was an enthusiastic supporter of the system. He indicated that his union was using the program in a major new instructor training program for 80 union trainers based on GPRO principles. His involvement is discussed in the next section.

5. Support for Instructors on Climate Literacy

Every union or training facility had its own arrangements for instructor training. In most cases, this was also linked to programs provided by their international unions, although some instructors indicated that they had graduated from the public college and university system in Canada, and one had been a US university faculty member previous to joining the union's training centre. Several trades' trainers had chosen to obtain certification in specific 'green' training systems, such as the Green Building Council's LEED points system for low energy construction. They had done so both to upgrade their own knowledge base and to enable them to incorporate this knowledge into their teaching. programs.

As noted above, one national training director is using GPRO content as part of his program for training instructors in his union. He acquired a Master's GPRO certification in several trades from the New York based Urban Green Council. This qualified him to train instructors in his unions with the GPRO system and award them GPRO credentials. He had piloted this approach in one local and was now providing training in the system for 80 instructors across Canada.

Several of the interviewees were based in the US. They also shared with us what their unions were doing on climate related training. We noted above that one national US union training organization had established a "Green Advantage" program. This was the result of a successful application for government funding about a decade ago to develop climate related curriculum material. From this money, it had developed five teaching modules to add to its training program. Instructors from the union's training centres across the US can download the 'Green Advantage' lesson plans study guides, interactive modules and exams from the union training web portal. It also contains training videos for instructors to show in their classes.

Perhaps reflecting the polarizing controversies in the US over climate change, we learned that even though the courses were readily accessible to all instructors, they had not been that widely used in recent years. However, the training director – who had been an enthusiastic supporter of their development - indicated that recently there had been renewed interest in them, perhaps reflecting the emphasis on climate issues of the new US federal government.

Overall, we think there is considerable training material already available in the CBTU's affiliated unions for helping instructors for developing a climate literacy component for their training programs. Given the limited number of trades' instructors we have interviewed, we suspect that there is much more out there than we have thus far identified. And, of course, there is already considerable material developed by CLC affiliates outside the building trades and from other organizations such as the Canada Green Building Council both through its LEED program and through other initiatives it has pursued in recent years.

6. Inter-Trade Co-operation and Low Carbon Construction

There is extensive research, particularly in Europe, about the need for greater cooperation, communication and consultation among all stakeholders on building sites if they are going to succeed in implementing low carbon construction. This reflects the experience that quality standards must be very high. If any component of the work is not done properly, the overall goal of minimizing energy consumption and GHG emissions will not be achieved. As we note in our discussion of some of the weaknesses of LEED elsewhere in this report, failure of one, or several, components of the work can result in completely undermining the environmental objectives of a project. The 'performance gap' between project specifications and measured outcome has been the subject of a large volume of literature in recent years. While there are a variety of reasons for it, a major one is the failure of all participants in a construction project to work effectively together.

All interviewees were agreed on the need for - and benefits of - more cooperation among trades. As noted earlier, the term customarily used was soft skills. One training director commented that too often architects, planners, engineers and other trades did not recognize the importance and value of his trades' work and were not sufficiently concerned as to whether the scheduling and organization of his trade's work gave his members the time on job sites to do the work properly.

One interviewee felt that what was needed was for all trades to develop a better understanding of how buildings were an integrated system rather than a collection of siloed contracts and sub-contracts. For projects to be implemented effectively, all trades needed to adopt a system-wide understanding based on the principles of building science. This concept needed to be reinforced in the curriculum. Apprentices needed to understand how their work had to be integrated properly with that of the work of other trades on building sites. This approach is consistent with what we have learned about the experience of low carbon construction in Europe.

One interviewee noted how new technology could facilitate greater cooperation on building sites. Sophisticated software now enabled engineers and trades' workers to model an entire project and plan the work of each trade throughout the building process. Buildings could be constructed theoretically in 3-D models and every component thought through in advance and every trade consulted as appropriate. If used correctly this could ensure that work schedules and assignments were effectively coordinated to ensure input from all trades.

While modelling has been in place in parts of the industry for many years, such as computer models used in ship construction, the availability - and affordability - of new software is making this level of planning feasible on many more projects. The interviewee noted that the key to making this approach succeed was to include everyone in the initial planning and organizing of the work. Through computer modelling software, coordination of the work of each trade could be

done before projects even put shovels in the ground, significantly reducing the likelihood of trades failing to take account of the requirements of each other's work as they tried to meet tight schedules. However, the interviewee felt that the key to success was to ensure that all trades were 'in the tent' at the beginning so their knowledge and expertise would inform project planning.

However, he also noted that this also placed an onus on his trade to remain on top of this technology so that it could demonstrate that it could deliver high quality work using the latest innovations in construction practices.

These developments in technology can also facilitate more effective low carbon construction. Their use can reinforce the view that buildings are integrated systems in which all the components must fit together properly, and all trades need to understand how their work relates to that of everyone else on a building site. Making the connection between the use of new technology and successful low carbon construction opens the door to a conversation about how the resulting improvements in building quality can be a part of the process of developing effective climate change strategies.

7. Links Between Environmental Sustainability and Climate Change

One area that our interviews highlighted was the extent to which some of the training programs include a focus on protecting and preserving the environment, activities which fit well within a broad definition of promoting climate literacy.

For example, one interviewee described a program for teaching apprentices how to operate heavy equipment. It included training material and on-the-job examples to inform them of the impact their equipment could have on the environment and, in particular, on drainage, soil erosion, vegetation and topsoil. It provided apprentices with instruction in how to avoid triggering unnecessary water run-off and soil erosion as well as how to avoid the adverse consequences of re-directing stream flows. The rationale for this focus was not explained in terms of climate literacy but rather on the need for apprentices to develop an understanding of the environmental impact of their trade and, consequently, the importance of taking care of the physical environment as part of being a responsible trades person.

The instructor noted, for example, that it takes 1,000 years to create an inch of topsoil. But careless operation of heavy equipment could easily destroy what it had taken centuries to build up. Once destroyed, this was not something that could easily be replaced. There was a similar emphasis on taking steps to avoid pollution such as how to dispose of liquids like engine oil and chemicals used in the construction process. Years ago, the practice had, unfortunately, often been simply to drain these fluids into the ground. However, the curriculum now informed apprentices

of their responsibility to ensure that proper disposal practices were followed to avoid polluting the environment.

A number of other training instructors indicated that they regularly stress the importance of conserving energy in the use of equipment as well as minimizing air pollution from the operation of machinery. For example, not allowing diesel or gas engines to idle when not in use, even if leaving the machinery running was not a significant cost unless there was a good reason such as sub-zero temperatures for keeping it running. Instructors in several training programs indicated that they had deliberately acquired new, low energy machinery to demonstrate to students the advantages of shifting to environmentally friendly practices. They also explained the benefits of replacing diesel or gas equipment with non-polluting electric equipment. Another interviewee noted that recycling practices were being increasingly followed by his trade while earlier practice such as burning the coating on electrical wire to get the copper were no longer acceptable practices.

Apprenticeship programs were increasingly discussing the impacts of the industry on the environment. They were and encouraging apprentices to adopt environmentally responsible working practices. Encouraging apprentices to think about their impact on the environment is one element of climate awareness and something that a number of training instructors indicated they were emphasizing in their instruction.

8. Promoting Industry Awareness on How to Reduce Energy Consumption

Reducing energy consumption is an important part of addressing climate change. While one reason for energy conservation is to save money, another is that limiting energy use reduces demand on energy sources that produce GHG emissions. One instructor noted that his program taught apprentices the use of infrared thermography cameras to measure the energy profile of building components. This technology enabled them to calculate the potential energy savings of installing, or refurbishing, mechanical insulation in the piping and duct work of HVAC systems. The same kind of technology can also be used to identify thermal bridges and other sources of heat loss in buildings and its use is becoming common in a number of trades.

In addition to assessing energy savings, he showed apprentices how to use the technology to explain to building owners and contractors the potential volume of greenhouse gas emissions that improved insulation could save, measured in tonnes of CO2. The technology opened the door for apprentices to engage in a discussion about why reducing emissions and energy use was important not only to save money but also to reduce the impact on the climate. Because contractors were slow to recognize the commercial value of the technology, the also union took the results of its thermography calculations to building owners and encouraged these owners to contact competent contractors to do the insulation work. This illustrated how technology could

be incorporated as part of the training of apprentices, promoting climate awareness in the broader industry among building owners and contractors and providing more work for the trade.

9. The Role of Voluntary Building Standards in Promoting Climate Objectives

In our interviews, trainers discussed several of the voluntary low carbon energy standards that are currently in use. These standards are designed to recognize buildings that have lower GHG emissions, less energy consumption and higher standards of environmental practices such as water use or indoor air quality. They normally allow building owners to state that their building meets a higher level of performance than required by the building and energy codes. As we noted earlier, there are a number of different voluntary standards in widespread use today. Principle among them are ASHRAE (which is also included in some required codes), Passive House, R-2000, BOMA BEST and the Canada Green Building Sponsored LEED standard.

LEED was the most frequently noted of these. Because LEED focuses on reducing energy use, water consumption and related environmental objectives, its goal is clearly linked to climate literacy. All interviewees were familiar with the LEED point system. Several interviewees indicated that their training programs provided apprentices with an overview of the LEED standard as an option for promoting low carbon construction. One instructor felt that LEED was going to play a much greater role in the industry's future and, consequently, that apprentices would need to be familiar with it to enable them to keep abreast of developments in the building industry. LEED was here to stay.

Despite the climate and environmental goals of the LEED system, with which there was general agreement, several instructors felt that there were problems in how LEED was being implemented in practice. Some felt that the LEED point system was flawed, resulting in finished, highly rated gold or platinum LEED buildings failing to meet low carbon objectives. Among the reasons cited for the gap between design and performance was the lack of effective quality control on construction sites. There was no requirement for those working on LEED projects to be properly trained trades' workers. As a result, many LEED projects were being built by workers without the appropriate training and skills. Consequently, some building purchasers found that the energy profile of their LEED buildings was no better than conventionally designed buildings. Poor performance of the completed buildings undermined the reputation of this system as disgruntled purchasers concluded that they had not received good value for their money.

One trainer indicated that he felt that a weakness in LEED was that contractors were not required to use Red Seal qualified trades workers which undermined quality standards. He felt that the LEED system needed to be tightened up to require that only qualified Red Seal (or provincial equivalent TQs) be permitted to build these projects. This would encourage the industry to support more investment in workforce training while protecting the LEED system's reputation.

The LEED point system was also a subject of concern. Buildings could get a high point rating even if their energy performance was no better – in some case worse - than conventional projects in terms of their energy consumption. A LEED Silver or Gold rated building might have a very low score in an area critical to energy conservation but would still rank highly because of the points it received for other elements of the system. Consequently, LEED needed improvements both in its quality control over the building process and in the way in which points were allocated.

One interviewee felt that some developers were using LEED primarily as a marketing technique to promote their buildings compared to their competition. The idea of having a LEED building appealed to purchasers concerned about the environment and thus increased its value in the marketplace. However, without effective monitoring of the way LEED buildings were constructed and thorough measurement and inspection of the energy and environmental outcomes of completed buildings, many projects were not contributing significantly to meeting Canada's climate objectives.

Despite the concerns noted above, several interviewees noted that LEED and other voluntary building standards designed to promote low carbon construction do provide an important way to facilitate a discussion among apprentices about what the building industry can do to reduce GHG emissions and energy use. Consequently, despite the problems noted above, they have the benefit of contributing to the apprentices understanding of some elements of climate literacy.

10. Barriers to Expanding Climate Literacy in the Trades

As noted, most training programs only deal with climate literacy in a very limited way, even though many cover important climate related skills and work activities. However, the reasons given by instructors for not including more information on climate issues varied considerably. As we discussed earlier, one key reason was the absence of references to climate literacy in the mandatory Red Seal and provincial curriculum standards. This constrained training institutions to focus, narrowly, only on the skills that apprentices would need to pass their exams. Without formal Red Seal requirements, individual training facilities were left on their own to decide whether they wished to address the issue and, if so, how much emphasis to place on it. Lack of references to climate change in the Red Seal Standards also impeded the development of teaching materials that would facilitate introducing climate issues into the apprenticeship curriculum.

In addition, several interviewees noted that they were not trained in climate science – that was not what their expertise included – and hence they felt somewhat awkward in broaching issues where they might be out of their depth. This underscored the significance of the lack of direction

and support from the Red Seal and provincial regulatory bodies. It also pointed to the need for these organizations to provide trades trainers with appropriate training material dealing with climate literacy.

However, there were other reasons as well. One was the lack of demand in the industry itself for a climate literate workforce. Although some contractors and industry professionals, such as members of the Canada Green Building Council or BOMA, were supportive of construction projects that would facilitate the application of low carbon building practices, this was not characteristic of most contractors or those commissioning buildings. Lack of employer demand for apprentices knowledgeable about low carbon construction principles compromised efforts by trades training schools to include this material in their curriculum. Absent demand from employers, there was less incentive to include climate issues in the curriculum.

Another reason was the failure of those commissioning buildings to include specific climate and energy requirements in their specifications. Contractors build to the details included in their contracts. Unless the specifications indicate that specific low carbon approaches are required, including the use of qualified workers, contractors will continue to build in their customary way because this keeps their costs down and increases success in obtaining contracts.

The preceding factors indicate that training organizations need a more supportive industry environment to be able to promote low carbon construction practices in their curricula. This involves a cultural change in which saving energy and lowering GHG emissions become mainstream. At the same time, industry cannot move forward on this issue without being able to rely on a training system that ensures that workers have the relevant knowledge and skills. Both are needed.

11. Apprentice Interest in Climate Change Issues and Acquiring Climate Related Skills

There is an ongoing debate about whether young people are more interested in examining climate issues than their older counterparts. The general view is that they are. But our findings were somewhat mixed on this question. When we asked trades' trainers about whether they felt their apprentices were concerned about - or motivated by - an interest in climate issues, we heard varying answers. Most felt that young workers were attracted to the trade because it offered an opportunity for relatively secure, well-paid employment. This is not surprising and perfectly reasonable. However, several instructors indicated that a significant portion of their students were also attracted to the trade because it would enable them to fulfil their desire to make a difference for the climate. Responses varied significantly among different trades as well.

One instructor noted that there were challenges in his trade about discussing climate issues because some jobs to which his apprentices were assigned involved projects that were the subject of criticism by environmentalists as not being sufficiently 'green' or climate friendly. Yet these projects were offering on-the-job training and work experience needed by apprentices to learn their trade and get their ticket. In this context, he found discussions about the broader question of climate change were a bit awkward and he tread carefully in raising climate related issues unless they arose naturally in classroom activities.

On the other hand, another instructor indicated that grade 12 students in his pre-apprenticeship program were very engaged the discussions he initiated on climate change. They wanted to explore the issue even further than he had time to spend on it in his classes. In his case, there was a great deal of interest among young people entering the trade in what they could contribute to the climate.

Several other instructors did not see a big difference in the attitudes of younger versus older apprentices when it came to climate issues. So, while the fairly widespread view is that young people are much more concerned about climate issues, our research seemed to indicate that young people were only marginally more focused on what their trade could do to promote climate issues.

12. System Thinking and Treating Buildings as Integrated Systems

According to much of the literature, a key feature of effective low carbon construction is that it treats buildings as integrated systems in which all the components must fit together properly. Building science is the foundation for understanding the interconnection of the different elements associated with a construction project. Viewing buildings as integrated systems results in a focus on ensuring that everyone who contributes to the final product has an understanding of the role his/her trade plays and the importance of ensuring that the work assigned to his trade is performed to the highest standard. The practical application of building science involves teamwork, communication, collaboration and shared decision making during the various stages of a project.

As noted earlier, one of our interviewees repeatedly stressed the importance of adopting a whole systems approach to building projects. This applied not only in teaching this concept in the classroom to apprentices but also enabling apprentices to see it in their day-to-day activities as the appropriate way of organizing work on building sites. In his view, trades should be involved, wherever possible, at the beginning of the development of a project. It was essential that their understanding of the practical issues of carrying out their work informed how the project was planned and implemented. This required the trades to take a proactive approach in working with other trades on the team, as well as architects, engineers, planners and building commissioners to

solve problems collaboratively and come up with appropriate approaches to fulfilling the design specifications of a project.

Many other interviewees emphasized the importance of informing apprentices of the value of soft skills such as communication and cooperation among the trades as well as the importance of treating building projects as integrated systems, rather than as a group of siloed, individual sub-contracts.

We had hoped to hear more discussion about the importance of providing apprentices with a solid background in the principles of building science, but our sense is that the focus of much of the training is primarily on enabling apprentices to develop specific skills necessary to work in their trade. Of course, the two approaches are compatible. All trades need to know the core skills of their occupation. But we would have liked to see a bit more attention on the broader issue of providing a foundation in building science as part of the curriculum.

13 The Role of For Profit 'Green' Introduction to Construction Courses

Several training directors raised the issue of the proliferation of private, short term training courses offering micro-credentials. These are often advertised as a way to a 'green' job performing environmentally sustainable work. Their promoters claim that they provide job hunters with an entry to construction, normally by giving them some sort of "green" skill certification qualifying them to install solar panels, roof and wall insulation and so forth. Some have also been promoted as being pathways into the trades. Interviewees noted that the lack of adequate provincial regulatory requirements for certain construction skills has facilitated the growth of this problematic approach to training along with ill thought-out government subsidy programs which provide cash to residential homeowners to do this work.

Most interviewees were particularly critical of these programs. The micro-credential courses ignored the real technical challenges involved in doing this work and the corresponding skill level needed to do it properly. They failed to recognize that this work needed a grounding in the fundamentals of the trade as well as knowing how to work safely on a construction project. While seeming to provide a pathway to a job, the view of interviewees was that these types of courses frequently disappointed those taking them because they were narrow in scope and did not provide either the skills or the pathway to do other forms of related construction work. They did not provide those paying for the courses with a real, employable career based on a well-rounded apprenticeship, leaving them vulnerable to unpredictable changes in demand for the work. And they gave the public the mistaken impression that anyone could do this kind of work without needing to learn the basics of a trade.

The training directors contrasted micro-credential training programs with properly structured pre-apprenticeship programs, emphasizing that the latter provided enrolees adequate time to learn about the industry and the trade. Some of these properly structured programs lasted 6

months and covered the basic knowledge and skills necessary to begin a proper apprenticeship, including a pathway to an apprenticeship. One instructor noted that his union's pre-apprenticeship programs provided 95% of those completing them with entry into a proper apprenticeship and credit for the time they had invested if they went on to complete their apprenticeship.

14. The Role of Upgrading Courses for Qualified Journey Workers

A number of the interviewees indicated that their programs provided upgrade courses for qualified journey workers. These were normally in specialized areas, often associated with learning skills associated with installing energy saving technologies such as hydronics, solar electric installations and wind turbines. There was strong support for these kinds of programs among interviewees whose programs provided these courses because they reinforced the principle of lifelong learning which they saw as essential for the future of their trades. As one interviewee said: "The days when you completed your Red Seal and closed the books on further learning are definitely gone". Continuous upgrading of skills was also a way to ensure that their employers would be capable of continuing to win contracts because their trades were fully capable of implementing the latest technologies and working practices.

One interviewee felt that a major area for expanding climate literacy was precisely in the areas associated with new, green construction components. Providing tailored upgrade courses for working skilled trades in environmentally relevant areas, as well as providing opportunities for learning new technologies was an important function of the training system. Union schools could – and should - play a major role in supporting this trend. Instructors also felt that these courses should be made available at times and locations which did not interfere with a workers' normal job such as on weekends or evenings so loss of income was not a barrier to participation.

15. Health and Safety Training for a Changing Environment

All interviewees noted that their programs provided pre-apprentices and apprentices with a solid background about safe working practices on building sites. This also included knowing about the numerous hazards construction workers face on the job, such as exposure to unsafe equipment, toxic chemicals, asbestos and numerous other risks. Health and safety were an area in which interviewees felt that their programs were generally doing a good job.

There is a scientific consensus that global temperatures are rising and that the increases are disproportionately happening in some regions in Canada. Temperatures in parts of the north are

now averaging over 2 degrees Celsius over previous decades, while other parts of the country are facing localized temperature increases far above what has been customary in the past. The dramatic events in BC this past summer with its record 49.6-degree Celsius temperature reading, the wildfires in BC, Alberta and Ontario and the floods in other parts of the country underscores how the climate is changing.

Climate change means that construction workers are facing increasing hazards from temperature induced heat stroke, dehydration, cardiac failure and other temperature related events. The rise in other weather events, such as virulent storms, hurricanes and flooding is increasing the risks facing workers who have to repair the damage these events create. While storms, historically, have always downed power lines or resulted in localized flooding, the increasing ferocity of more recent storms exposes power line workers and other trades to greater hazards than in the past. The same is true of many other weather-related risks. All of this is to say that the changing climate is increasingly important as a driver of health and safety concerns for construction workers.

However, we did not hear that much about the link between health and safety training and the way in which the working environment is changing due to climate change. This is an area where there is a clear link between what is happening to the climate and the increasing exposure of construction workers to additional risks. This may have been because we did not press the issue in our questions. But it did not come up spontaneously in our interviews either. We assume that this challenge is being covered in some of the health and safety programs. However, we would have liked to have heard a bit more about the connection between the changing climate and the way in which measures to address it is being incorporated into health and safety programs. This is an area where all trades have the opportunity to develop a link between apprenticeship training and climate change.

16. Employer Influence on the Content of the Curriculum

Earlier in this report, we noted that employers have a significant role in determining the content of the apprenticeship curriculum. One way is through their influence in shaping the skills that are included in the Red Seal Standards. Although they are only one partner in this process, along with provinces, colleges, unions and the Federal Government, the reality is that training programs are focused on giving the workforce the skills that employers need. So, their input is very significant in shaping the actual curriculum. The fact that the Red Seal Standards do not incorporate a significant climate literacy component is a reflection that the employers have not seen this as being all that important to date.

Because many training facilities are jointly managed by unions and employers, decisions about pre-apprenticeship, apprenticeship and upgrade courses for journey workers also reflect, to a

very large degree, the concerns and interests of employers. As noted, these are based largely on their demand for qualified labour. This impacts curriculum because training facilities want to ensure that their apprentices are job ready with the relevant skills needed to work on the projects contractors succeed in winning. Employers also influence the demand for post-apprenticeship skill upgrade courses for qualified working trades.

The market in which employers operate also influences curriculum content. Employer demand for low carbon skills is dependent on the specifications of contracts. These are determined by what those purchasing construction services want in the buildings they commission. To the extent that demand for low carbon construction remains limited, employer requirements for workers with a solid knowledge of building science and the skills, knowledge and competencies of green construction practices is correspondingly limited

Not surprisingly, a number of the trainers made the obvious point that contractors build according to the specifications in their contracts. If those who commission buildings and the engineers who they employ do not indicate that they are ‘green projects’ or that the contractors must use workers with specific skill sets and credentials, they will use the cheapest labour they can find. So upstream specification requirements significantly impact on what is practiced on job sites limiting the extent to which practices such as low carbon construction are being implemented.

Employers also affect the take up of climate related skills if they do not set a clear example that they expect apprentices to practice these skills on their construction projects. This also can create a conflict between what apprentices may learn in the classroom and what contractors ask them to do on the job. If contractors do not attempt to follow low carbon construction practices or cut corners in the implementation of standards such as LEED, this creates a disconnect with the classroom training apprentices are receiving. It sends the wrong message. And if instructors believe that the contractors employing their apprentices are not interested in promoting ‘green’ construction, then this may also affect the extent to which they feel it makes sense to cover climate issues in their curricula.

Of course, the training system cannot, on its own, magically generate employer demand for low carbon construction practices. And employers themselves are constrained as noted above to implementing what those commissioning buildings require. But to the extent that provincial and municipal building regulations and those commissioning construction services increase their demand for more climate friendly buildings, there is an onus on employers to support efforts to introduce these practices in the industry through supporting the training system.

17. Recognition of Higher Performance Standards Required for Low Carbon Construction

As noted earlier, one of our interviewees strongly emphasized the need for members of his trade to adopt a lifelong approach to learning. It was essential that members of his trade keep on top of the numerous changes in technology and materials that were constantly being introduced into construction work. He noted that LEED projects were becoming more common and felt that this trend would continue, necessitating members of his trade to develop a clearer understanding of the underlying goals and principles of LEED and other low carbon construction methods and integrate them into their day to day working practices.

He also felt that the onus was on members of his trade to demonstrate that they were on top of the new technologies and could show the industry that they implemented them efficiently and competently. They had to demonstrate their value to the industry. Otherwise, they would face increasing challenges from contractors in the unorganized sector who could argue that the unionized skilled trades were not significantly better at implementing green construction practices and hence they, rather than unionized contractors should get the work.

On the question of the higher standards of performance required for low carbon construction, one interviewee noted that this could be illustrated by the problems that had occurred with ground source heat pumps and geothermal systems. Government subsidy programs encouraged installers with little or no background in plumbing, pipefitting and the electrical trade to enter the business. But lacking the appropriate trades training many did not understand the need to treat these technologies as integrated systems in which every component had to be installed properly and to precise specifications. As a result, many were not built right. Energy savings were far below expectations, giving the technology a poor reputation among disgruntled purchasers. Aside from the misuse of resources, poor installation practices tended to undermine the rapid adoption of these technologies despite their demonstrated excellence if put in place properly. This was one example of the 'performance gap' between the specifications of 'green' building technologies and systems and the actual performance of completed systems.

In discussing the role of LEED standards in buildings, one interviewee noted the importance of ensuring it was done properly. This meant by workers with the appropriate trades training. Because LEED bases the grading it gives to a building based on a total points system LEED can certify a building as meeting a gold or platinum standard even though an area critical to energy reduction may be deficient. There were also concerns that LEED was being used largely as a marketing technique by some developers rather than a serious method of meeting Canada's climate objectives.

One trainer indicated that he felt that a weakness in LEED was that contractors were not required to use fully qualified trades workers. Non-union LEED installations often failed to deliver the full benefits due to the workers' low skill levels and lack of training. In the absence of

enforceable regulatory standards, the only way to ensure that LEED was properly installed was to use unionized trades. Union members were fully trained, and unions placed a premium on keeping member skills current and on top of new technologies and working methods. While it might not be possible politically to implement a union only requirement, LEED projects should require that those working on them minimally, have a Red Seal.

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18. Climate Literacy and the Emergence of a More Representative Workforce

Climate literacy, broadly defined, includes the view that the way society addresses the climate crisis should include principles of equity, inclusion and social justice. This has been reflected in the work of unions in developing models for a just transition to protect workers from the adverse effects of economic restructuring in response to climate change. This also means promoting measures that will facilitate a more representative workforce and address issues of under representation of various groups in our society.

Every interviewee indicated that his training programs were committed to providing greater opportunities to women, aboriginal people, immigrants and other groups who, historically, have been under-represented in the construction workforce. Interviewees provided numerous examples of initiatives that their training schools were taking to create a more representative workforce. In some cases, interviewees gave us quite specific data on the percentage of women, First Nations and others enrolling in pre-apprenticeship and apprenticeship programs. In others they lacked the data but said that addressing under representation was a priority.

Some union training facilities had established specific programs or courses for First Nations and other indigenous apprentices. One interviewee noted that twice a year the entire intake of apprentices into his program was composed exclusively of First Nations members. Another noted the effort his union had made to partner with various First Nations bands to encourage their members to apply to its apprenticeship program. Others had built connections with a wide variety of community organizations to recruit those traditionally excluded into their apprenticeship programs as well as setting up pre-apprenticeship programs to support the transition. Because tool belts, work boots and wool socks were difficult for women to find in the region where one training facility operated, it purchased these in bulk for its female apprentices.

It also provided links to local child-care facilities as well as limited subsidies to assist women overcome this barrier to apprenticeship. While support for a more representative trades' workforce intake was also a result of government programs that targeted these groups, much of it reflected decisions by instructors and their training facilities to pursue this goal.

At the same time, interviewees acknowledged that under representation in apprenticeship intake remains a problem and one that training schools were still finding difficult to overcome. Some programs had few or no women in a number of their courses. In others, representation of indigenous people, new immigrants and other traditionally excluded groups was not known because there was no effective system for collecting demographic data. This was acknowledged as a significant problem.

We also heard that there were ongoing problems on some work sites which were not welcoming to women, aboriginal apprentices and other under-represented groups. This resulted in a high rate of dropouts from some apprenticeship programs. It also meant that many of those who received their Red Seal left the trade a few years afterwards because they found the culture of the workplace too difficult to cope with. Instructors were aware of this problem and training schools had taken measures, such as mentorship programs, to address it. But it remained a major challenge which the industry will have to address more seriously in the coming years.

One area which, in retrospect, that we could have investigated in our interviews more thoroughly is how publicly funded community benefits agreements (earlier referred to as project labour agreements) can link the training expertise of unions with efforts to bring more diversity into the construction workforce while giving apprentices an opportunity to learn skills needed for green construction. These agreements normally include commitments to local hire and training as well as providing opportunities from groups underrepresented in the trades through outreach and mentoring programs. Community benefits agreements also open a pathway to the trades because they provide a commitment to ensuring that apprentices will get the work necessary for them to progress through their training and eventually get their ticket.

Unions are well positioned to support this development and hence can play a critical role in promoting them, as many have done in recent years. Community benefits agreements are generally well supported in the broader community because they offer training and employment opportunities to new groups of workers otherwise excluded from the construction industry. To the extent that they provide infrastructure needed to transition to a low carbon economy, they also can merge equity goals with climate objectives within a framework of unionized projects paying decent wages and providing good employment conditions.

19. Addressing the Impact of Climate Change on Vulnerable Communities

A significant body of research indicates that the effects of climate change will fall disproportionately on the most vulnerable groups within our society. It is these groups that have the fewest resources and least capacity to adapt to the impacts of the adverse changes that climate change will bring in the coming years. In addition, some public policies, such as carbon taxes, intended to reduce our use of energy and other resources, also place an extra burden on those with low incomes because they have fewer resources to cushion the resulting price increases or to invest in energy conservation initiatives such as retrofitting their homes.

The building industry can play a major role in addressing this issue by constructing new buildings that meet net zero carbon targets and retrofitting the existing building stock to reduce energy use. In doing so, it can reduce the financial burden faced by building occupants, including those who are most vulnerable to energy price increases, while ensuring that the buildings themselves meet higher standards of occupant comfort, safety and indoor air quality. The building trades are critical to this process because they are the people who are qualified to perform this work and who are responsible for ensuring that building standards and design goals are fully met.

A climate literate workforce ideally should be mindful of the impact that its work will have on those who live and work in the buildings it constructs. It should also be aware of the broader societal benefits associated with its contribution to the building process. Traditionally, construction workers like to take pride in the exercise of their skills and the knowledge that the projects they work on are well built and durable. However, in the context of climate change, the exercise of these skills also has the broader effect of contributing to reducing society's carbon footprint and making a substantial contribution to addressing some of the disparities being created by climate change.

In our interviews we touched briefly on this issue. One trades director made the point that the skills he was teaching apprentices were not just to enable them to get a pay cheque. It was also to ensure a livable planet for his children and grandchildren. It was to give apprentices a sense of pride in the work they were doing and an understanding of their important contribution to society. It was to promote values which encourage workers to take responsibility for the quality of their contribution to the building process including their role as active participants in implementing measures to address climate change.

In some of our interviews with other trades' instructors we found similar views about the importance of doing a good job and ensuring that apprentices understood the value of their skills. However, we also found that many instructors were not emphasizing the link with climate change. As with some of our other observations on this issue, we concluded that the values being promoted were supportive of the development of climate literacy, but that the language in which they were expressed needed to be expanded to acknowledge the positive role the building trades

can make to addressing climate change, including advancing climate justice. While training programs cannot, in themselves, overcome the problem of disparities in living and working conditions faced by vulnerable groups in society, by ensuring that the future workforce is representative of vulnerable groups they can contribute to ensuring that their needs are better understood and better addressed by members of the trade.

20. Reducing Embedded Carbon

One aspect of 'greening' the construction industry involves shifting to the use of materials which incorporate less energy or less embedded carbon. Promoters of low carbon construction believe that using more environmentally sustainable materials is necessary to maximize the reduction of GHG emissions. This means knowing about the carbon footprint of various building materials and taking steps to use those that have the lowest footprint. With some exceptions, instructors told us that occasionally they do talk about this issue. Bu, in general, providing this kind of information has not been a high priority in the curricula of their trades' training programs. This is primarily because decisions on materials used in the construction process are made by building purchasers, architects, engineers and contractors who draft the specifications. So, on many building sites, the ability of the trades to influence selection of materials is quite limited. They don't make the choices.

However, knowledge of the carbon and energy content of materials is relevant to the extent that trades have some influence over how the building process is organized and hence whether some materials are to be preferred over others. Moreover, trades may be more current on the newest options available than other stakeholders further up the decision ladder and may be able to use their knowledge to push for the use of more climate friendly options when the opportunity arises. And it should be remembered that some apprentices will end up being supervisors and project managers as their careers develop so having this knowledge can ensure that when they have more discretion over the selectin of materials, they will make informed choices.

In addition to selecting more sustainable materials, another way to reduce the carbon footprint of the construction process is to minimize the generation of waste and recycle what cannot be used. Instructors told us that their apprenticeship programs cover issues such as waste management and recycling where trades have some control over these decisions. However, as with the selection of building materials, responsibility for these areas is largely under the control of employers.

Avoiding unnecessary use of water is another way in which energy use can be reduced as well as promoting conservation of this resource. One interviewee noted that his program did focus extensively on water conservation issues, and these were linked to environmental sustainability goals. He even told apprentices they should not be wasting water when they used their

toothbrushes! Saving all water – but especially heated or cooled water - was one important way to reduce energy consumption in addition to its other environmental benefits. As with the points noted on carbon emissions above, this issue is one that is consistent with having a climate literate perspective.

21. Conclusion

Our interviews indicated that that most of the skills currently being taught are ones that the industry will need to address climate change in the future. The training instructors were clearly knowledgeable about what kinds of skills apprentices needed to practice their trade and their programs were providing these skills. Our main finding was that there was not enough connection between how skills were being taught and why they were critical to implementing low carbon construction practices. Apprentices were learning the how, but not the why. In addition, programs were not enabling apprentice to learn about the way in which their industry and the skills they learned could contribute positively to implementing Canada's goal of reducing its GHG emissions and energy use.

We found that a major barrier to the development of a more climate literate workforce was the absence of training material in the Red Seal Standards. Climate change has not been a focus in the way the Standards have been developed in the past and this is reflected in the exclusive focus on skills training. Most instructors felt there was some scope even within the current Standards to include basic information about climate change and some were doing this. However, as one interviewee noted, it would be helpful if the Standards themselves included this material, both because it would confirm that it was appropriate curriculum content and because it would provide some basic information about what instructors should include on the issue in their training programs.

Another barrier was the lack of support in the industry for the development of a workforce that has the knowledge and competencies to implement low carbon construction successfully. Contractors build according to the specifications in the bids they win. If those who commission construction projects and the architects and engineers who they employ do not prioritize 'green' construction in the specifications, low carbon practices will not be encouraged. Despite the growing awareness of how the changing climate is affecting the industry, the culture from top to bottom is still not taking account fully of the way in which construction practices will need to change to respond to what is happening to the climate and the overall environment in the coming decades.

We also learned that interviewees believed that the training programs should place a greater emphasis on 'soft skills' such as the ability to communicate and collaborate on building sites, as well as the capacity to understand how the work of each trade fitted in with the others in working

on a construction project. We heard that there should be more emphasis on apprentices learning a systems approach to their work in which they could see how their specific tasks contributed to the overall success of a building project. The industry and the trades training system has the capacity to encourage the development of a climate literate workforce. It only needs a nudge to point it in the right direction.

Appendix 2

Build it Green: CIRT European intermediate report, January 2022

The European Team's remit

The European team has been investigating different approaches to incorporating climate literacy into construction curricula and, more generally, into vocational education and training (VET) systems, including for apprentices and the current construction workforce. It has sought above all to identify the different roles of stakeholders, including unions, employers and employers' organisations, local authorities and governments, associated with particular approaches. These roles are at the same time indicative of the importance attached to knowledge, skills or know-know, and attitudes or competences in the curricula and of the extent to which VET is, at one extreme, purely employer-based and, at the other, education- based.

For example, in the employer-based system of the UK, and especially England, both unions and employers' associations are formally excluded from reviewing the plumbing or electrical apprenticeship frameworks, which is in the hands of individual employers. It is only because these employers are themselves members of employers' associations and of the Joint Industry Boards consisting of employers and unions, that unions and employers associations have a say, albeit indirectly. In contrast, in Sweden, the Swedish National Agency for Education decides on the framework for VET and qualifications, though social partners (unions and employers) as well as the teachers are consulted, and teachers are responsible for developing the curricula and syllabi for different construction courses. Thus, whilst the social partners influence the development of construction VET, it is essentially education-based, with the first 3 years in a school or college, and only the last as an apprentice in a firm. The result is that in England there is considerable emphasis on the skills and tasks required in the workplace, whereas in Sweden the knowledge component is greater (see Grytnes et al 2018).

Our intention is to highlight different approaches to incorporating climate literacy into the curricula, to evaluate what impact the different stakeholders have on this development, to identify good practice examples of VET systems, qualifications and curricula where climate literacy has been successfully integrated, and to show the different meanings and elements attached to climate literacy. In this way, we will provide examples for the CIRT team to benchmark Canadian building trade curricula and VET programmes against and to assess the approach to VET these entail, the roles of the different stakeholders involved, and the incorporation of knowledge, skills/know-how and attitudes/ competences.

The examples are selected on a range, from employer-based, to social partner-based to education-based, and include: England, Wales, Scotland, Ireland, Denmark, Germany, Belgium, and Sweden. For each case, we focus on particular trades, in particular electricians, plumbers, carpenters, and insulators and electricians, and evaluate:

- how climate and energy literacy has been incorporated into curricula
- whether and how occupational interfaces are addressed and interdisciplinary learning is facilitated
- the extent to which curricula seek to develop competences such as communication, team-working and self-management
- the challenges and barriers to developing and delivering climate literate curricula
- the role of stakeholders, including trade unions, employers, colleges, municipalities, and government and the ways in which they collaborate in developing and delivering effective VET

in zero carbon construction. As a result, we hope to develop a framework that illustrates the relationship between: a) different stakeholders; b) the approach to VET and in particular the understanding/definition of climate literacy; and c) how climate literacy is embedded in curricula. This interim report describes progress so far and plans for the immediate future.

Progress so far

Since October, when the contract between CIRT and the University of Westminster was finalised, we have conducted seven individual interviews, 5 of which were via zoom and 2 face to face, plus two visits, one to Wales and one to Ireland, involving 3 group discussions, one in Cardiff, one in Waterford and a third in Enniscorthy. In Wales the group discussions included 9 interviewees, in Waterford 5 and in Enniscorthy 3, totalling altogether 16 individuals. All in all therefore discussions have taken place with 23 different individuals:

For the UK generally

1. The Energy and Emerging Technologies Advisor, Electrical Contractors Association (virtual)
2. National Apprenticeship Skills Officer, Unite the Union (virtual)
3. Industry Insight Manager, Construction Industry Training Board (virtual)

For England:

4. Deputy Principal, West London College (virtual)

For Wales

5. SERO Homes CEO (face to face)
6. Group discussion at Cardiff and Vale College (CAVC) with:

i. Chief Regional Officer, Department for Economy, Skills & Natural Resources
ii. Future Generation Wales representative
iii. CAVC Deputy Principal
iv. CAVC Director of External Funding
v. CAVC Dean of Technology and Creative Industries
vi. CAVC Associate Dean of Technology and Building Services
vii. 3 CAVC trainers

For Ireland

7. Group discussion at Waterford NZEB Centre with:

i. Area Manager (JC), Waterford and Wexford Education Board (WWETB)
ii. WWETB Innovation and Development Manager
iii. WWETB Quality Assurance Manager
iv. WWETB Plastering Tutor
v. Limerick Institute of Technology project worker (EO)

8. Discussion at Enniscorthy NZEB training centre with:

i. NZEB Trainer, MosArt Training Academy
ii. Passivhaus builder (MB)
iii. WWETB Innovation and Development Manager

9. Interview with Irish construction union (SIPTU) officer (face to face)

For Sweden

10. Senior Policy Advisor, The Swedish Installation Federation (virtual)
11. Education Coordinator, The Swedish Construction Federation (virtual)

Interviews and group discussions were recorded and notes taken to compare with the zoom transcripts obtained. Summaries of the virtual interviews are now complete and we are in the

process of writing up those conducted face to face and preparing summaries of the visits to Wales and Ireland. We plan to provide country-specific cases, covering altogether 8 countries (England, Wales, Scotland, Ireland, Germany, Denmark, Belgium and Sweden) and each focussed on different examples that encapsulate and reflect the main characteristics of the respective construction VET system, the approach to embedding climate literacy, and the stakeholders involved.

Briefly, some of the main considerations to emerge from the interviews carried out to date are:

UK generally

All in all, the UK is at a low level of development in terms of incorporating climate literacy into the curricula of the different construction occupations. In large part this is due to lack of regulation by government and the insistence on an employer-led system, the marginalisation of trade unions and employers' associations, and lack of recognition of national occupational standards. Many initiatives on the ground by the different industry organisations and in the separate nations – Wales, Scotland, and Northern Ireland – represent attempts to overcome these restrictions.

Much attention has been given to the possibility of retrofit programmes and the skills required for this, largely focussed on insulation and the installation of heat pumps, mainly air- source for domestic. The role of Retrofit Coordinator has been developed but insulation is not a recognised occupation, and the Construction Industry Training Board (CITB) is only now developing national occupational standards for this. The skills seen as required for retrofitting include 'soft skills' such as communication. CITB is only now turning to the skill requirements for newbuild.

Building services, including electrical and plumbing, do not come under CITB and here there is more attempt by the Electrical Joint Industry Board (JIB), consisting of the unions and the electrical contractors association (ECA) to introduce climate literacy into the apprenticeship framework, above all through the development of a Level 3 domestic electrician apprenticeship, due to be introduced in April. This includes onsite generation, such as small wind energy storage, heat pumps, load control, and all the smart technology to reduce energy consumption and maximise efficiency, control systems etc. It is thus mainly a question of introducing new technologies.

Electrical contractors need to be registered on the Microgneration Certification Scheme, which requires that work such as heat pump installation is done correctly. The ECA has also been encouraging its members to use PAS35 as a framework for installation, required for local authority and housing association work, which is intended to ensure that work is carried out in a coordinated fashion. However, electrical and plumbing work are beset by private training providers and companies purporting to train electricians to, for instance, install solar panels in just a few weeks. The union demands that a competent person needs to be a judicial entity and qualified under a personal specification scheme; only in Scotland is Level 3 recognised as a minimum level of competency.

With plumbing, this Level is recognised, both in England and Scotland. However, of the four pathways to becoming an intermediate craft plumber (Level 3) – oil, solid fuel, gas and environmental technologies – few have signed up to environmental technologies and gas remains the most popular route. The plumbing qualification framework is coming up for

review, an employer-led process in which educationalists are not involved. For plumbing and electrical apprenticeship standards are followed by an assessment plan, on the basis of which a qualification handbook is designed and subsequently given to the training provider, the Further Education College.

Further Education (FE) Colleges themselves are hampered by a lack of demand and of a work-based training infrastructure given extensive self-employment, subcontracting and the dominance of micro-firms. As a result, the majority of construction trainees are full-time in colleges, in anticipation of eventually obtaining a work placement. For instance, in the London FE College interviewed, which covered all construction trades, there were 500 full- time and 200 part-time students and only 150 apprentices. As across the country, colleges rely on initiatives from local and in particular metropolitan authorities, in the form in the case of London of the Greater London Authority Mayor's Construction Academy, which seeks to coordinate and promote 'green skills' through promoting hubs of key stakeholders, including employers, universities and local authorities but rarely unions. A key problem, however, is the facilities; whilst the workshops in the Welsh (Cardiff) college visited had solar panels and heat pumps for trainees to learn how to install, the London College did not have heat pumps. FE Colleges envisage, however, that more stringent procurement requirements, including for supply chain contractors to adhere to PAS35 standards, will gradually come in and will help to create demand.

Wales

The Welsh government is more proactive than that prevailing in England both in relation to VET and environmental policy. For instance, a recent major policy announcement made in the *Programme for Government* included the launch of the *Young Person's Guarantee*, aiming to support under 25-year-olds into education, training or work, and create 125,000 all- age apprenticeships in Wales. Wales is a self-governing region of the UK, though with limited powers exercised through a unicameral parliament (Senedd). VET is closely aligned with the English system in terms of overall approach and curriculum although Wales follows its own policies to some extent and has issued a number of reports on various aspect of the VET system in Wales. It uses UK national qualifications like City and Guilds and BTEC but has not taken up the T levels which are the English government's preferred qualification at level 3 (upper secondary leaving certificate equivalent).

We visited Cardiff and Vale College (CAVC), where discussions took place with a range of stakeholders (see above) and which has a flourishing apprenticeship programme as well as an extensive college-based programme in the construction sector. There was good evidence of well-equipped workshops, including a mock house to demonstrate air tightness, and enthusiastic and knowledgeable staff. In terms of procurement, we found some limited evidence of the use of procurement policy to drive low carbon building, with for example National Resources Wales (a government agency) and the Welsh Government's own housing programme committed to low carbon new build. The Welsh government works with some innovative private sector organisations pursuing a low carbon strategy through consultancy and partnership, notably SERO which is company specialising in low carbon as opposed to low energy housing construction. SERO has worked with other partners on 500 low carbon new build houses and 2,500 retrofit units since 2017 and provides expertise in achieving net zero carbon aligned with the decarbonisation of the grid.

Ireland

The field trip to Ireland took place on 18-19 October 2021 and involved visits to Waterford and Wexford Training Centre and the two NZEB centres in Waterford (fabric focus) and Enniscorthy (energy focus). The case study is based on evaluation of NZEB training developed by the Waterford and Wexford Education and Training Board (WWETB). These are short, further education type courses (Continuing VET – CVET) designed to support the upskilling of experienced workers in the industry but suitable for adaptation for the training of apprentices or initial VET (IVET).

The transition to 'green' buildings in Ireland is guided by European Union (EU) legislation, including: the European Performance of the Buildings Directive (EPBD, 2021/2018/2010); the Renewable Energy Directive (2021/2009) and the Energy Efficiency Directive (2021). The legislation mandating the transformation of buildings is designed to deliver the EU's growth, energy and climate change strategies, most recently articulated in the 2030 Climate Target Plan (2020) and the European Green New Deal (2019) and the Renovation Wave for Europe (2020) set in motion with the objective of reaching net zero in 2050. All member states are required to transpose the EU legislation into national law and regulations.

Accordingly, NZEB became mandatory in Ireland for construction starting on or after 1 November 2019 in order to meet the requirement of the EPBD that from 30 December 2020, all new buildings are nearly zero energy buildings (NZEB). The new building standards are set down in Part L of the Building Regulations. The meeting of these standards is a key measure in Ireland's Climate Action Plan (2021, updates 2019 plan) and identified in Action 50 of the plan to skill-up current contractors/other industry players in deep retrofit, NZEB and new technology installations. The Climate Action Plan takes a 'just transition' approach.

The Ireland 2019 Climate Action Plan committed to the following measures:

- Improving the fabric and energy efficiency of our existing buildings
- Rolling out zero-carbon heating solutions, predominantly heat pumps and district heating networks
- Planning for the full phase out of fossil fuels in buildings by 2050
- Progressive strengthening of building standards for all types of buildings
- Promoting the use of lower carbon alternatives in construction
- Promoting behavioural change in how households use energy

In addition to the above, the targets of the 2021 Ireland Climate Action Plan are by 2030:

- Effectively phase out the use of fossil fuels for space and water heating in all new buildings
- Planning for the phase out of fossil fuels in existing buildings
- Complete 500,000 residential retrofits to achieve a B2 BER/cost optimal equivalent or carbon equivalent
- Install 600,000 heat pumps in residential buildings (of which 400,000 to be installed in existing buildings)
- Deploy zero-carbon heating to the meet the needs of 50,000 typical commercial buildings
- Deliver up to 2.7 TWh of district heating, with the exact level to be informed by the outcome of the National Heat Study
- Develop the calculation framework and databases in order to set performance standards to

promote the construction of low-carbon technologies on a phased basis.
(Source: Ireland 2021 Climate Action Plan, 2021:115-116)

As part of the Climate Action plan, a National Retrofit Plan has been set in motion and the Public Sector Energy Efficiency Programme foresees an enhanced role as leaders setting the standards through good practice examples. Support for the expansion of the NZEB training centres is part of the government strategy to ensure the upskilling of the construction workforce. The Action Plan for Apprenticeships (2021-2025) aims to review and upgrade apprenticeships across all industries to respond to current skill needs, to create a more inclusive system and double the number of apprentices in the next 10 years (Source: Ireland Apprenticeship Action Plan, 2021).

Training for NZEB - beginnings

Efforts to equip the workforce with the appropriate expertise began with Ireland's participation in Build Up skills, an EU-wide initiative of the Intelligent Energy Europe Programme (IEEP, 2007-2013) programme. The aim of Build Up Skills (2012-2013) was to map the training needs of the construction workforce, support the development of national road maps and kick-start training programmes and qualification schemes across the EU. In Ireland, following the completion of a national status quo analysis and roadmap of action and funded by the IIEP the QualiBuild project (2014-2016) set out to address some of the challenges identified through two pilot training schemes: The Foundation Energy Skills Programme and Train the Trainers, Federation. The Foundation Energy Skills (FES) pilot training was completed by 196 workers, Train-the-Trainer by 59, with participation thought to have been affected by the downturn in the industry.

A key feature of QualiBuild was that it involved a broad range of stakeholders including five main partners of the Limerick Institute of Technology, the Irish Green Building Council and the Construction Industry Federation, Dublin Institute of Technology and Institute of Technology Blanchardstown, supported by a steering group of 14 organisations from industry and education. As part of QualiBuild, an online register of site operatives and craft workers trained in low energy building was set up, The Construction Worker Skills Register.

NZEB training – steps towards national roll-out

Following the completion of the pilot programme, led by the WWETB, the Foundation Energy Skills (FES) course was further developed and adapted to different trades as a first step towards the objective of national roll-out. Currently, there are 10 separate short courses, first trade-specific courses in Europe. These include:
NZEB Fundamental Awareness (1 day) NZEB for Electricians
NZEB for Plumbers NZEB for Carpenters NZEB for Bricklayers NZEB for Plasterers
NZEB for Construction Workers NZEB for Ventilation
NZEB for Site supervisor NZEB for Retrofit

The Limerick Institute of Technology was contracted by the WWETB to lead the upgrading of FES. The courses are City & Guilds 'assured', which was preferred as a faster route to launch, because validation by Quality Qualifications Ireland (QQI) takes 2 years. The syllabi were agreed between March-July 2018 and the first introductory course was delivered by WWETB in September 2018, and the first trade-specific course in January 2019. There has been a steady increase in attendance on the different courses, totalling 582 until the Covid 19 lockdown in

March 2020, including for NZEB fundamentals (457), electrical (18), retrofit (36), plumbing (6), ventilation (60) and carpentry (5).
As with the original QualiBuild project, a notable feature of this development process has been collaboration with other agencies and organisations, including employer organisations and trade unions, training bodies, private companies with expertise in energy-efficient construction, and the active support of the Irish government. The stakeholders include:

- Department of Education and Skills
- Department of Housing, Planning and Local Government
- Department of Communication, Climate Action and Environment
- Sustainable Energy Authority of Ireland
- SOLAS
- National Standards Authority of Ireland
- Irish Green Building Council
- Construction Industry Federation
- Connect Trade Union
- Limerick Institute of Technology
- Carlow Institute of Technology
- Waterford Institute of Technology

A further development is the construction of an International Centre of Excellence in High Performing Buildings in Enniscorthy supported by the United Nations Economic Commission for Europe, in a process driven and co-ordinated by a local contractor.

Course delivery

The courses are delivered at the two training centres in Waterford (building fabric focused) and Enniscorthy (energy focused), currently partially online due to Covid 19 restrictions. The teachers/instructors of the WWETB Training Centre are among those completing the training. The courses are currently delivered by MosArt, the contracted training provider, which is a subsidiary of a well-known Passive House designer & builder. Courses are delivered on-demand and cost 100 Euros a day. The courses are not part of the national qualification system and thus are not defined by a 'level'. It is advised that the Fundamentals is Level 3-4, and the other courses aimed at qualified tradesman are around Level 6. The participants are awarded the WWETB NZEB Digital Badge by City & Guilds, indicating that the NZEB Training Programmes are benchmarked against their quality standard. Plans are under way to set up NZEB training centres in other regions and roll-out the courses nationally.

Sweden

Sweden has had well-insulated buildings for a long time (since 1970s) and so carpenters, who are responsible for insulation, are familiar with it; there is not a separate profession called 'insulator'. The main issue with the guidance of the Swedish National Agency for Education is that the framework is very general so that, for the upcoming review, more detail and deeper knowledge is being sought. A huge problem in Sweden has been lack of training for teachers following the reform of 2011 as well as the focus only on pedagogical issues, not technical or trade specific matters so that teachers have to rely on their own experience. In collaboration with the electricians' training board, the Swedish Construction Federation developed a continuing education programme for teachers, financed by the Swedish Energy Agency with funds obtained from the Build Up skills programme. Despite the lack of organized competence development, this has been implemented by cooperating training boards, run by the social partners in construction and installation, with 500 out of 1500 VET-teachers participating.

Architects and engineers make the decisions regarding energy efficiency specifications, whilst workers implement them and need to be trained well so that they do it correctly. This education must:

- provide knowledge about rational, safe and environmentally sustainable construction, the industry's various professions and work processes;
- give students the opportunity to develop their knowledge of the industry's responsibility for sustainable development;
- give students the opportunities to develop knowledge of common professions and work processes in the building and construction industry and what sustainable development means in the industry.
- give students the ability: to cooperate and communicate with others; use professional language appropriately; understand the role of the building and construction industry in society and with regard to sustainable development; and use resources linked to sustainable development and company profitability such as material handling, storage, minimization of waste and sorting of construction waste.

Next steps

The immediate next step is to complete writing up of the summaries of interviews and visits carried out so far and to evaluate these more closely, involving research to present a more complete picture. This will be followed by interviews with those already contacted in Scotland and Denmark, and developing programmes for visits to Denmark, Sweden and Germany in February – covid permitting.

References

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Appendix 3

Build it Green: CIRT Progress Report from the United States, January 2022

Methods: Interviews and Fieldwork

I began the research on climate literacy by speaking with the National Association of Building Trades Unions (NABTU) Training Director. He offered his overview of the way climate literacy is being incorporated into the trades, and introduced me over email with the International training director for the Insulators. The NABTU director helped me obtain a letter of endorsement of the study from Sean McGarvey and provided me with a list of the names of the directors of national union training facilities

Although many of the directors did not respond to a request for an interview, the list helped me develop a strategy for finding trainers around the country. In consultation with the CIRT team, I interviewed curricula developers and instructors from the Urban Green Council, the National Electrical Alliance, the Training Director of the solar facility of a major IBEW local, a curriculum developer at the International Training institute for the Sheetmetal/HVAC trades. I went on to interview the outgoing and the new training directors for the United Association of Plumbers and Pipefitters, a trainer for the Operating Engineers (Stationery side), and an on-staff consultant for the Division of Apprenticeship Standards in California. I interviewed an elected state officer of the Allied Trades, and the director of the Illinois Climate Jobs Coalition. Finally, I spoke to the Secretary Treasurer of one of the State Labor Councils and the president of a Laborers local who also works for the State Building Trades.

In addition, I had first-hand experience with climate or green trainings. I attended the Urban Green GPRO fundamentals online class and experienced what the dialogue and learning experience might be in a virtual course. I also participated in a national face-to-face three day train-the-trainer class in climate energy and green skills at the United Association of Plumbers and Pipefitters in Chicago. On day two, the attendees joined a public summit on the future of climate technology and jobs in geothermal exchange, along with contractors, the national training director of the UA, elected officials from Chicago, as well as State Senator Chris Hanson from Colorado. Jay Egg, a consultant and designer of major geothermal HVAC systems at large facilities around the country gave the featured presentation. During these events, I had a chance to speak with trainers and labor leaders from around the country and hear about the challenges and opportunities they faced. I toured the model UA training facility that was fitted with climate-friendly features including a green roof, solar heated water, advanced boilers, rainwater and greywater systems. In addition to the applied labs and classrooms in that building. I visited a state-of-the-art training trailer that gives students hands-on applications for clean energy installation and service. This was one of several model training centers I learned about. I viewed a powerpoint of a Sheetmetal training facility with similar advanced applied training and heard descriptions of several others.

Attending theses trainings gave me a chance to closely analyze the curriculum. Curricular materials from other sources are quite challenging to obtain. I was sent books on automated

building controls by the IBEW but did not receive a copy of the solar training. I received, a textbook on heat pumps from the UA, and three sets of curricula from Urban Green that were used by the UA. I was given review materials for two tests for the UA. I requested curricular material, instructors' guides and notes from many other trades, but the majority were unable to provide that material without supervisor's consent which has not been forthcoming. My impression is not only that these materials have proprietary content, but there is a general unease about where the materials will be used. "We don't know where these instructional materials will end up" was the answer from one trade. "Things float around and once it's out of our hands, we have no control." This is an indication of several issues in the trades in the United States that include jurisdictional disputes and concern about non-union training.

Overview of Climate Literacy and the Building Trades

Surveying the trades in the United States for best practices on climate literacy is yielding numerous lessons. The research tells a story of US building trade unions actively engaged in addressing a green transition in reaction to the climate crisis. Each of the interviewees provided examples of how their members are involved with new technologies, codes, legislation, and opportunities that require training interventions. Although there is a haunting and actively voiced concern that movement away from fossil fuel will cause employment disruptions, the interviewees reflect the view that the climate crisis has changed the industry and they must respond.

Climate literacy training is dynamic; it is not just a set of texts, tests, and lectures, although those are vital elements. The interviews explore the weight unions give to preparing members to understand why and how to work differently in the face of climate change. There were a range of answers across the spectrum on what climate literacy means, why it is important, and how it relates to green skill training. This deserves a great deal of attention which I begin to elaborate on below.

How the trades experience the changes in the industry, how they react to them and incorporate climate literacy in their training requires some explanation. In the United States, unions are on the defensive, always looking for opportunities to put their members to work. They don't want to relinquish a traditional area of training for one that is still emerging, but they don't want to miss out on any opportunities. This paradox comes to the fore in the discussion of climate literacy and green skill training. There is enthusiasm for climate jobs and training but many different ideas about how to incorporate knowledge of climate science, its wider implications for construction work as well as how to train on collaboration, teamwork, communication. There are some trainers or union leaders who embrace the need for social inclusion and working with community, and others who are less concerned.

One of the instructors who urged that training should include climate science and inclusion argued that the message would generate excitement about what workers in the trade can do to make people's lives better.

We do need to make sure that we bring it back to why we're making this energy transition and understand that there is a severe impact to how we've been doing things for these decades upon

decades and we're feeling those consequences now. Our time is running short of when we can really make change to avoid some of these disasters that are coming, so we need to make sure that the climate is part of the dialogue. That we're encouraging solar, not because we want to put our members to work. We're encouraging solar and energy storage because we want to make people's lives more resilient. We want to make sure that the environment is there for future generations.

Another enthusiastic advocate of promoting climate jobs had a different way to message his members about climate literacy, stressing that change is a job creator and there will be a need for more workers to be trained for the green economy. Speaking of how he communicated a need for climate literacy to his members, he stated.

...it's a little bit more blunt. It's hey, cleaning up this disaster that exists means a lot of work for us it means pension hours to you, it means you know, putting more people to work that increase our collective bargaining power. So it is this kind of a whole host and I could get down the points, but it pretty much is you know, a jobs creator.

Many of the tradespeople I spoke to personally acknowledged their concern about climate change but explain that there is not uniform acceptance in the trades. Several of the trades offer the GPRO fundamentals syllabus and test as an elective or module that locals can adopt if they choose to, and the patterns of which areas use the curriculum follow, to some extent, political lines. The Fundamentals module sets out the principles of climate science such as CO2 rise correlated to carbon emissions, complete with graphs and explanation of the consequences of global warming. It provides the learner with factual information of the negative impact of fossil fuel and the need to phase it out. Fundamentals also alludes to the impact of climate change on vulnerable communities and policies that are being used to offset that disproportionate effect. The course ties the problem of climate change to human causes and the built environment's substantial contribution to carbon emissions. It addresses the range of actors in the construction industry and how the industry can make a difference with focused examples on building materials, the importance of the building envelopes, and references to renewable energy sources. There is a special focus on what the trades can do to achieve high performance energy efficiency. The value of this module is that it does provide "the why," why lowering emissions is critical, not just because of cost-savings but in order to create a more resilient and equitable society.

One of the challenges of utilizing the GPRO curriculum is how to make it interactive as that is not necessarily built into it. Someone can race through the powerpoint and workbook without engaging students in meaningful discussion. This is called the "banking " method of education (Paolo Freire) which tends to make a superficial impression on the learner, instead of providing time for learners to problem solve, to question, and to make the material relevant to their own thinking so that they feel engaged and motivated.

Interviewees gave many examples of how they teach green skills in a way that makes a connection with climate science. In the following excerpt from an interviewee, the reasoning for changes in a common trade application is explained in reference to its effects on the atmosphere, emissions and global warming. A clear relationship between green skill training, problem solving and climate

change is made.

We are also seeing an increase in our standards for refrigerant... You know the acceptable limits of refrigerant leakage has changed and also the types of refrigerant being used is changing. We originally had a CFC that was very, very prevalent, but that caused ozone depletion so we phased away from to a new formula. But while it didn't cause high ozone depletion it caused a huge amount of global warming. We traded one bad thing for a different bad thing right, and we went from the frying pan to the fire. So now we're phasing away to a newer type of refrigerant which has low ozone depletion and low global warming potential, but it's mildly flammable. So we are having some extra training, possibly some different certifications around how to work with our a lot of those different types. But we also have a book published internally for our purposes that's a green lead construction for our trade. That book includes case studies of like high performance buildings, you know, trends of global carbon dioxide and carbon cycles and building utility use.

How trades determine the need to communicate climate literacy to apprentices and journeylevel workers varies by several factors. Based on the interviews, I focus here briefly on geography, the market, social mobilization and government action. The relationship of the trades to the expansion of jobs within their jurisdiction is another critical factor, one that will require an addition to this preliminary discussion of findings.

Interviewing instructors from across the country shows that geography is an underlying structure that shapes union apprenticeship training. It helps explain both the variety and the differences of apprenticeship training and interest in climate literacy across states. Programs are supervised by the Department of Labor through the Bureau of Apprenticeship Training or by state boards (as in California) or both. Like the US federalist political structure, unions have some oversight and influence from national and international government agencies, but also follow state structures.

On the industry side, apprenticeship training is routinely generated and administered by joint labor and contractors' committees which have national or International as well as local levels. For the large trades like electrical, plumbing and pipefitting, insulators and sheet metal for example, reports are that much of the curriculum is generated on the national level, but locals can pick and choose what they want to include past a core set of classes. The decentralized structure of training reinforces the regional differences across the fifty states of the union. While there are standards and guidance from the national level, state and local apprenticeships respond to the market, politics, and culture of their area. Third parties like Urban Green Council partner with union trainers to develop climate literacy modules that unions can use in their apprenticeships and their journey level upgrades.

The decline of fossil fuel in the market and the global shift towards renewable energy touches every trade I spoke with. Shifts in the market raise questions and uncertainty as well as

opportunity in every area. Along with legislation, unions voiced that increased market emphasis on decarbonization provides opportunities for unions to become active in getting jobs and shaping labor standards where work is growing and may be non-union. Unions use devices like project labor and prevailing wage agreements as tools to ensure their members access to good quality jobs created by the drive to decrease emissions. More work in the greening economy increases the need for incorporating some type of climate literacy training, whether it be installing or servicing new or updated equipment or learning new ways to work as part of a composite crew.

Equity is being infused into the meaning of climate literacy in North America. Social mobilization and changing demographics create pressure on the trades and their apprenticeships to alter traditional hiring practices. The Black, Brown, Asian, Native American and Women's Freedom Movements of the 1960's and 70's contested the historic racial, gender, ethnic segregation in good-paying unionized jobs, with a particular focus on manufacturing and the trades. The demand for equity continues to grow strong and, in some places, these advocates join with the climate justice and environmental groups to form coalitions to pass climate and social legislation. Social movements, like labor, see the development of the green economy as integrally tied to concerns about labor standards and workforce development, but also equity. Younger and more ethnically diverse workers are attracted to these movements and bring these ideas and expectations into the apprenticeship, concerned about jobs but also their health and their future.

Climate legislation is a large factor contributing to how trades experience the need to be proactive about climate literacy and green skills. When the federal government authors Executive Orders or passes legislation that affect state institutions and practices or when the state comes out in front of the federal administration and passes climate legislation there can be rapid changes for labor. When the Biden administration came out with an Executive Order to decrease emissions in federal workplaces, unions saw that as an opportunity to train for climate jobs such as increasing energy efficiency that is not only based on keeping down costs.
California climate legislation affects the local market, with contractors needing workers who have more climate jobs training to meet the rising bar of Title 24, for example.

Unions are not bystanders to these developments but in fact are often actively engaged in influencing, negotiating, and implementing policies that are in play. How unions position and prepare their members to participate in climate jobs is tied to equity in several ways, including building pipelines and retention schemes for under-represented groups. Illinois' 2021 Climate and Equitable Jobs Act was advocated for and negotiated by a coalition of diverse trade unions, environmentalists, entrepreneurs and the state government, with "each group getting something of what they wanted." Among other things, it funds union pre-apprenticeship programs that are being located and developed with equity requirements infused by the experience of climate literacy training several of the trades have already institutionalized.

What the interviews reveal

Analyzing the interviews with NVivo software, I found that most of the discussions centered around the following themes:

Education and training
Focus on Green skills
Inclusion of Climate Science Content in Curriculum
Addressing the Impact of Climate Change on Vulnerable Communities
Concern about appearing to diminish or abandon work and workers in fossil fuel Questions about which green technologies will be adopted
Inter-Trade Co-operation and Low Carbon Construction
Tests, certificates, job requirements and details of apprenticeship Pre-apprenticeship
Upgrading Courses for Qualified Journey Workers Health and safety

Methods of developing and conveying climate literacy
Curriculum development on national, state, and local level
Production of educational materials as modules either integrated or optional Working with third parties to develop climate literacy materials
The GPRO Model for Introducing Climate Literacy into the Training System Instructor Flexibility in Designing or conveying the Curriculum and training Support for Instructors on Climate Literacy
Geographical factors that influence climate education and green skills around the country
Applied training methods: labs, trailers and support for smaller locals
Union training facilities as models of green technologies

eflection on the drivers of climate literacy
Interaction and collaboration with contractors and government
Active engagement by training directors and labor leaders in shaping state and public policy and funding
Influence of manufacturers, contractors, building owners and managers
Preparing union members with the knowledge and skills necessary for the green transition
Demand from members for climate literacy
The relationship of equity to climate literacy, a more representative workforce, union strength and government policy
Opportunities and Barriers to Expanding Climate Literacy in the Trades

Next Steps

The interviews produced a wealth of information on climate literacy and green skill training in each of the trades that the codes help to organize. It will take some time to go through all of the interviews and create a picture of best practices from each of the trades. I plan to analyze the apprenticeship structure more closely to find the inflection points for interventions that

might have the most effect to encourage more training on climate literacy. The Red Seal exams for Canada are clearly one area to target. Another might be encouraging the committees that update standards for apprenticeships to include the why as well as the how of green construction.

As you can see from the code themes, many of the union facilities have built out their centers as models for applied training, serving not only local members but also providing a center for members to travel from around the country. They look at climate literacy from various perspectives that range from health and safety to cooperation with other trades and preparing members and the next generation of tradespeople for climate jobs. They consider how climate literacy can build the power of unions as they deliver what people need and work in concert with communities to raise labor standards and improve conditions for all.

One point I'd like to note is that in speaking with trainers from across the trades, those who focused more on green skills and climate mitigation than climate science often echoed what the Canadian research team found. Many of them felt that it would strengthen their curriculum if they provided a deeper emphasis on the why of green training, not just the how. This came out in their discussions of the younger generation of workers bringing their questions and knowledge about climate change to the classroom and the workplace. It came out in discussions of why many of the trades were working with Urban Green's curriculum which uses climate science as a foundation for connecting the need to lower emissions with construction work in general (GPRO Fundamentals), as well as how their trade specific contributions to lowering emissions need to be thoughtfully carried out according to energy standards.

The stories told by the various interviewees provide an insightful view of the various questions to be considered as CBTU and its researchers develop their curricula for climate literacy.

Vivian Price, January 9, 2021 (updated March 13, 2022)

Appendix 4

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 find and assess scientifically credible information about climate, and communicate it to others,
2. respects ecological and Indigenous[1] knowledge 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, combatting climate change can have uneven and potentially disruptive effects on the economic and social well-being of people and communities
6. can make informed decisions and about 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, 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,
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, can make informed and responsible decisions, problem-solve, collaborate with others, and apply knowledge creatively 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/energy environment,
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.

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 that are heating our planet. It recognizes that positive changes in society ae required to promote a healthy, sustainable, inclusive and biodiverse planet.

[1] Indigenous here is used to mean "a place-based human ethnic culture that has not migrated from its homeland and is not a settler or colonial population. To be indigenous is therefore by definition different from being of a world culture, such as the Western or Euro- American culture" Stewart, G (2018) What does 'indigenous' mean, for me? Educational Philosophy and Theory,50:8, 740-743, p 740.

Appendix 5

How is Training for Low Carbon/Low Energy, "Climate Literate" Construction Different from Training for Conventional Construction?

A key question for those promoting climate literacy in the trades is: "What is the difference between the kind of training required for low carbon/low energy construction (LEC) and the requirements for conventional construction."[1] "How can we distinguish between the two approaches?" The following points are an attempt to identify the key differences:

Low Carbon Construction Training Emphasizes the "Why" (climate change) as well as the "How" (skills development)

LEC training is designed to provide apprentices with an understanding of the role that the construction industry can play in addressing the challenge of climate change and environmental degradation. It promotes 'climate literacy' which involves learning about the key findings of climate science and the reasons why scientists are so concerned about the impacts of rising global temperatures on our species. It emphasizes the significance of the challenge of mitigating and adapting to climate change and underscores the key contribution that the building trades can make to reducing GHG emissions, energy use and achieving other sustainability and environmental objectives.[2] It provides apprentices with an understanding of why implementing low carbon construction is now so important and why their contribution can make a real difference.

Low Carbon Construction Augments Traditional Skills by Adding Climate and Energy Awareness

Traditional Red Seal construction trades' training provides apprentices with the tools they require to practice their trade. It is very skill oriented and focuses on teaching them how to perform specific tasks competently. LEC training builds on traditional skills' training by promoting a deeper understanding of building science coupled with the development of 'soft skills', that is the ability to communicate and collaborate with

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others working on a building site

[1] A number of related terms are commonly used to refer to low carbon construction. These include net Zero which means a project will have no carbon emissions at all when its entire carbon footprint is measured. Normally, this means it will be producing some energy through solar, wind or other renewable sources to offset any energy from the grid used in its operations. A related term is nearly Zero or near Zero. This indicates a project that – as the name implies – is transitioning towards zero carbon emissions. However, the goal may only be to minimize emissions and not necessarily to self-generate energy. For the purposes of this discussion and to avoid the confusion of using a number of closely related and often overlapping meanings, we have used low carbon construction (LEC) as a proxy for these other terms.

[2] There is a distinction between GHG emissions and energy use. GHG emissions track the amount of carbon and other greenhouse gasses released into the environment and are measured in the number of tonnes (megatonnes or MT) of carbon released through fossil fuel burning. While carbon is the dominant substance measured, GHGs also include methane, nitrous oxides and fluorinated gasses. Energy as the name implies involves measuring the Kilojules used in heating, cooling, transportation and other activities. There can be differences between GHG emissions and energy use for purposes of assessing the

climate impact of buildings although there is normally a great deal of overlap.

It gives apprentices an understanding of the role that other trades play in the construction process, reducing the 'gaps' in their understanding of the contribution other trades make to a successful project. It encourages closer coordination and joint problem solving on building sites to facilitate effective integration of the work of all trades.

Incorporation of a Building Systems Approach: LEC training incorporates a building science approach that views buildings and infrastructure as integrated systems, not a set of individual contracts. It encourages apprentices to view projects from a whole building perspective. It promotes the view that competent performance of each step of construction, from initial design through to completion, site clean-up and final evaluation is essential for achievement of a project's goals. This means that the relationship among the various components is of critical importance. There can be no weak links. While it is important for training for individual trades to focus on learning and applying trade specific skills that save energy and lower GHG emissions, this must be augmented by knowledge of how the trade's work contributes to - and must be integrated into - the larger objectives of the construction project. A systems approach emphasizes the need for everyone involved - developers, architects, engineers, contractors and skilled trades - to work together collaboratively to ensure that the final product meets the design objectives. Thus LEC training promotes a deep understanding of the 'bigger picture' of the numerous ways the construction process affects GHG emissions, energy use and the environment.

Workforce Training and Skills Development: While recognizing the importance of learning trade based skills, LEC training encourages apprentices to develop a thorough understanding of the principles of building science and the contribution their trade makes to the overall building process. Low carbon construction requires much more precise workmanship because even small gaps in the work can undermine the energy performance of the building. Consequently, LEC construction requires high quality craftsmanship and responsibility for outcomes. It also encourages apprentices to take pride in performing work properly and contributing to the positive climate impact of projects. LEC training also requires apprentices to take greater personal responsibility for their trade's contribution to successful building projects. It encourages innovative thinking, the exercise of personal judgement and problem- solving skills. LEC training promotes a culture of continuous learning and personal development after completion of the apprenticeship and throughout the individual's future career in the trades.

Promotion of a 'Green' Workplace Culture: LEC training promotes the development of a workplace culture in which quality of work outputs and the achievement of climate and energy objectives become core values. This involves cultivating positive attitudes towards implementing the highest quality of workmanship and taking pride in building projects which achieve positive climate, energy and environmental outcomes. Training connects the design objectives of low carbon projects with the broader societal goal of

addressing climate change. A green culture also considers environmental impacts in the selection and operation of machinery such as replacing diesel with electric engines.

Importance of Following Design Specifications Carefully: LEC training clearly recognizes that the specifications of LEC projects are drafted with the goal of reducing the energy use and carbon footprint of the construction process and the resulting building projects. The specifications are more precise and detailed in areas associated with minimizing the impact on the environment, energy use and GHG emissions. The design of LEC projects focuses on those elements in the building process - and the final output - that are linked to clearly identified and measurable climate objectives, most notably GHG emissions and energy use, but also a range of other measures that reflect the environmental impacts of construction processes and outcomes. Apprentices learn that successful LEC projects incorporate provisions for the measurement of building energy use during construction and through the operational life of building projects. They also learn about the GHG impacts of the construction process and its outputs. LEC training embeds this content into the curriculum.

Materials: LEC training promotes an understanding of the concept of embedded carbon in the inputs and materials used in the construction process and its impact on GHG emissions. While recognizing that the selection of materials is often not under the control of individual trades, it encourages apprentices to understand the importance of minimizing the use of materials with a large carbon or energy footprint and, where possible, to use substitutes that are environmentally benign such as timber rather than steel or cement. This involves learning about the whole life-cycle approach to measuring energy and carbon content of the entire building process as well as the impact of decommissioning buildings at end of life, including the extent to which the materials used can be reused or recycled. Finally, it recognizes that building materials can have significant adverse health effects on workers and building occupants.

Water Management: LEC training encourages apprentices to think about ways to conserve water during the construction process. It avoids treating water as a ‘free good’ that can be wasted. The training also warns apprentices about releasing contaminated water into wastewater systems or the adjacent environment when they are cleaning up building sites. Because construction projects can disrupt natural water systems LEC addresses this issue and identifies measures needed to protect the environment from such disruption. It also explains the importance of ensuring proper installation of heat pumps, HVAC systems and mechanical systems that recover the energy in heated or cooled water through heat exchangers and water recirculation technologies.

Recycling and Waste Disposal: While conventional construction training addresses issues of waste management, LEC training gives greater emphasis to the value of reusing material from demolished structures as well as salvaging materials left over from the construction process. This is both to avoid creating demand for new materials and to preserve the carbon in materials that can be recycled. It encourages apprentices to minimize the generation of waste and to ensure that disposal of materials discarded

from the building process is done in an environmentally responsible way if they cannot be reused or recycled. This is particularly important where materials or substances may be hazardous and therefore must be disposed of in a way that avoids endangering the health or well-being of workers, building occupants or the wider public.

Relationship of Construction to the Environment. LEC training emphasizes that the building process - as well as its outcomes - has a significant impact on the environment as well as GHG emissions and energy use. It explains how projects can dramatically change the landscape, redirect streams, eliminating large swaths of farmland, forests and floodplains and contaminate both the site and the adjacent area. LEC training promotes an understanding of these issues and seeks to cultivate an awareness of the broader environmental impacts of construction on land use, foliage, streams and wildlife as well as on the human population. LEC construction considers the environmental impacts of construction materials, the construction process and the resulting building project's impact on the overall environment, including waste management, protecting groundwater, topsoil, trees and other foliage and wildlife. While decisions about projects are often outside the control of apprentices, they do exercise some discretion on building sites and can reduce adverse environmental impacts of the construction process. Teaching awareness of construction's environmental impacts and their environmental responsibilities as construction workers is a key component of LEC training.

Collaborative Working Practices: A key focus of LEC training is explaining why construction requires much closer cooperation and collaboration among all those involved in the building process. Instead of viewing a project as a collection of individual contracts and sub-contracts, it emphasizes teamwork and shared responsibility for outcomes. Collaboration may involve clients who fund projects, developers, architects, engineers, skilled trades, technicians and others involved in construction projects. Each profession or trade needs to have a solid understanding of how its contribution will fit into the overall objectives of the project. This involves knowing about the work of others on the job site and utilizing decision making processes that take the work of others into account. LEC projects emphasize teamwork, interdisciplinary problem solving and respect for the contribution of everyone involved in the construction process. LEC training supports a cultural change in the industry that focuses on shared responsibility, quality of workmanship and doing work properly as opposed to cutting corners and finding ways to avoid, or minimize, contractual obligations.

Additional Low Carbon Training and Qualifications: LEC training goes beyond adding specific new 'green' technical skills to what apprentices currently learn. It requires apprentices to have a solid understanding of the basic principles of building science, greater competency in organizing work and more sophisticated operational skills in performing specific tasks. It includes an overview of the major rating systems such as LEED, R2000, Passive House, Energy Star, Living Building Challenge and others. This involves appropriate training in LEC concepts and methods as well as specific technical and new skill qualifications for building 'green' projects and adapting traditional skills to

new applications. In addition to learning new technical skills, LEC construction requires a workforce with the 'soft skills' capacity to communicate effectively and work collaboratively with others in implementing a project's design specifications. LEC training also focuses on shaping attitudes and the culture of the workplace – and the workforce – to include a strong commitment to successful low carbon construction outcomes.

Knowledge of Changing Building and Energy Codes: Canadian building codes are increasingly focused on achieving environmental and climate objectives, including lowering energy use and reducing GHG emissions. Conventional apprenticeship training focuses on learning the key details of the building, energy, fire and other statutory codes and regulations that apply to each trade and to the building sites on which apprentices work. However, LEC training also focuses on why the building codes have been written and explains their basic policy rationale. It assumes that apprentices should understand the link between meeting the legal requirements of the codes and achieving the broader objective of Canada's climate commitments. Rather than seeing the codes simply as burdensome government regulations that
add costs and complicate the work of the trades, LEC training emphasizes how meeting - or going beyond the codes - is something the industry needs to do to fulfil its - and Canada's - climate obligations.

Promoting Healthy and Rewarding Workplaces Like conventional training, LEC emphasizes that projects must not produce health and safety risks for those working on them or those affected by the construction process and its building outcomes. The introduction of new, 'green' technologies and working practices must be informed by careful assessment of potential risks and include measures to avoid them. Beyond this LEC training encourages apprentices to expand their knowledge of the construction process so that they will have the knowledge and capacity to handle new technologies and working systems safely. It promotes problem solving, creativity and continuous learning both to reflect the ongoing changes in the industry and to promote the development of workers themselves. LEC encourages workers to exercise judgement, competencies and skills and take pride in their contribution to construction projects. It supports a respectful working culture designed to support positive mental health outcomes. LEC training recognizes that the well-being of the workforce is a significant factor in organizing and managing construction projects and supports the view that there should be opportunities for trades to have an effective voice in shaping the building process.

Meeting the Needs of Building Occupants; LEC training emphasizes to apprentices the many benefits of green construction for building owners and occupants, including lowering energy costs and reducing long-term maintenance and repairs. Residential occupants, particularly those on low incomes, benefit from lower energy and operational costs. LEC projects reduce fuel poverty which is linked to ill health and higher mortality. Competent LEC construction makes buildings more comfortable, reducing the adverse

impact of drafts and temperature fluctuations while improving indoor air quality and minimizing occupant exposure to airborne pollutants and toxics. Low carbon construction projects improve working conditions in buildings and can raise employee job satisfaction and productivity. LEC training emphasizes that apprentices can contribute positively to ensuring that these benefits are achieved.

Continuous Assessment and Evaluation and Performance Monitoring: LEC training emphasizes that construction projects should be planned and organized to facilitate detailed and ongoing measurement of energy use, GHG emissions and other environmental impacts during the building process and on completion of the resulting structures. It underscores the importance of careful inspection and, as appropriate, introduces measurement technologies, such as thermography and blower door tests that assess whether buildings are achieving their design specifications. It also promotes independent quality assessments to ensure that projects achieve their climate change objectives.

Environmental Justice. LEC training locates learning about climate change within a framework that recognizes that climate change disproportionately affects vulnerable populations. Measures to address it must incorporate social justice, equity and reducing discrimination, both at the workplace and in the impact of construction on the wider society. Aside from basic ethical concerns, addressing climate change requires broad population support. Policies that include environmental justice are more likely to obtain this support because of their perceived fairness and inclusivity.

Appendix 6

Why Construction Trades Have a Valuable Role in Meeting the Climate Challenge

Addressing climate change is the most important issue facing Canada and the world today. The latest scientific assessments by the IPCC (2021) paint a depressing picture of the extent of the challenge we now face, reinforcing the need for a much more concerted effort to implement climate mitigation objectives as well as sharply increasing investment in measures to adapt to the adverse impacts of global warming. [1]While the Paris Agreement commits governments to try to keep the increase in global temperatures below 2 degrees Celsius - ideally, below 1.5 - the prospects of achieving this objective appear increasingly slim. [2]

Canada is already experiencing the impact of global warming as evidenced by the alarming increase in wildfires, floods, extreme temperatures, droughts and melting permafrost.[3] Governments at both national and international levels have officially recognized the need for tough measures to lower the emission of greenhouse gasses and eventually phase out the use of carbon emitting fossil fuels. The Federal Government has established ambitious targets of cutting emissions by at least 40% by 2030 and 100% by 2050. [4] Most Provincial and municipal governments across the country have established comparable climate objectives.
Establishing targets is important. But the real question is how to achieve them. Currently buildings account for approximately 18% of overall GHG emissions in Canada, underscoring the importance of lowering the carbon footprint in this sector. The IPCC (2014) believes that major gains in building efficiency are feasible with existing technologies and at costs that are reasonably affordable, a finding echoed by the Senate of Canada's 2018 report on emissions in the built environment and private sector market researchers. [5] All levels of government in Canada have established policies intended to move us

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[1] IPCC, 2021: Summary for Policymakers: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar6/wg1/#FullReport

[2] United Nations Framework Convention on Climate Change (UNFCC) (Paris Agreement) 2015. Geneva. (Entered into Force Nov. 4, 2016). https://unfccc.int/sites/default/files/english_paris_agreement.pdf ; United Nations Framework Convention on Climate Change. (UNFCC) 2021 Nationally Determined Contributions Under the Paris Agreement: Synthesis Report by the Secretariat. https://unfccc.int/sites/default/files/resource/cma2021_08E.pdf

[3] Commissioner of the Environment and Sustainable Development for the Parliament of Canada. (2021) Report 5: Lessons Learned from Canada's Record on Climate Change. Ottawa: https://www.oag-bvg.gc.ca/internet/English/mr_20211125_e_43956.html: Office of the Auditor General of Canada; Bush, E. and Lemmen, D.S., ed. (2019): Canada's Changing Climate Report; Government of Canada, Ottawa, ON. 444 p. http://www.changingclimate.ca/CCCR2019. Canadian Institute for Climate Choices. (2020) Tip of the Iceberg: Navigating the Known and Unknown Costs of Climate Change for Canada. December. https://climatechoices.ca/wp-content/uploads/2020/12/Tip-of-the-Iceberg-_-CoCC_-Institute_-Full.pdf.

[4] Environment and Climate Change Canada. (2021) Government of Canada Confirms Ambitious New Greenhouse Gas Emissions Reduction Target. (Press Release) Ottawa: July 12. https://www.canada.ca/en/environment-climate-change/news/2021/07/government-of-canada-confirms-ambitious-new-greenhouse-gas-emissions-reduction-target.html

[5]IPCC (2014). Mitigation of Climate Chnge: Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change Chapter 9: Buildings. pp.671 – 738. https://www.ipcc.ch/report/ar5/wg3/buildings/; Senate of Canada. (2018) Reducing Greenhouse Gas Emissions from Canada's Built Environment. Report of the Senate Standing Committee on Energy, the Environment and Natural Resources. Ottawa. https://www.sencanada.ca/content/sen/committee/421/ENEV/reports/ENEV_Buildings_FINAL_e.pdf; Dodge Construction Network. 2021 World Green Building Trends: Smart Market Report. Bedford MA. https://www.corporate.carrier.com/Images/Corporate-World-Green-Building-Trends-2021-1121_tcm558-149468.pdf

towards this objective, incrementally, through reducing GHG emissions and energy use in new and refurbished buildings. The goal is to achieve net zero by mid-century. [6]

Federal, provincial and municipal governments have established a variety of policy tools to encourage the construction industry to do its part in this process.[7] Funding for climate research has increased significantly in recent years as governments realize the need to identify and introduce a range of new technologies and new construction materials. Building and energy codes have become increasingly stringent, requiring dramatic reductions in both the energy used in the construction process and the energy consumption of the finished structures.[8] Municipalities have used zoning and building approval powers to require much higher standards of energy conservation with the goal of net zero by 2050. Several cities have announced that they will no longer permit installation of heating and air conditioning systems using natural gas and other fossil fuels in the near future.[9]

To achieve climate objectives, every component of the construction process will have to undergo fundamental changes. Those who commission and purchase buildings must require much higher standards of energy efficiency. Developers, architects and engineers will have to ensure that their building plans and specifications meet climate objectives.[10] Contractors must deliver construction services that fulfil these specifications and do so in a way that minimizes adverse energy and environmental impacts. [11]Municipal inspectors will have to expand their focus from the traditional emphasis on structural integrity and fire safety to enforcing the new climate-related standards of increasingly tough building and energy codes.
And governments at all levels will have to find creative ways to deliver on their policy promises.

Understandably, there has been considerable discussion of the role of each of these 'players' in meeting climate objectives. But there is one major gap in much of the literature on achieving net zero construction and in many government policy statements. It is the role of the construction trades' workforce in this

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[6] There are a confusing number of terms to describe reductions in energy use and GHG emissions. These include: Low Carbon, Zero Carbon, Net-Zero, Net Zero Ready, Low Energy and so forth. Each has a specific definition and they can be differentiated from one another. Lowering carbon emissions is not the same as lowering energy use, although in practice there is considerable overlap. However, for the purposes of this paper, I have used the term Net-Zero to signify a building that has no carbon footprint either through passive design or through self-generating sufficient electricity to meet its needs. I have used low carbon, as the name implies, to signify buildings that still generate some GHG emissions and require some energy, but far less than conventional ones.

[7] Canada. (2016). Pan-Canadian Framework on Clean Growth and Climate Change. https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework/climate-change-plan.html

[8] Lockhart, Kevin and Brendan Haley (2020) Strengthening Canada's Building Code Process to Achieve Net-Zero Emissions. Efficiency Canada and Carleton University. Ottawa: October. https://efficiencycanada.org/wp- content/uploads/2020/10/Strengthening-Canadas-Building-Code-Process-to-Achieve-Net-Zero-Emissions.pdf

[9] Toronto (2021) Transform TO to Net Zero Strategy: A Climate Action Pathway to 2030 and Beyond. November. https://www.toronto.ca/legdocs/mmis/2021/ie/bgrd/backgroundfile-173758.pdf ; Vancouver (2020) Climate Emergency Action Plan. October 22. https://council.vancouver.ca/20201103/documents/p1.pdf. Others are banning gas altogether. https://www.cbsnews.com/news/cities-are-banning-natural-gas-in-new-homes-because-of-climate- change/

[10] Stevenson, Fionn and Alison Kwok. (2020) Mainstreaming Zero Carbon: Lessons for Built-Environment Education and Training. Buildings and Cities. https://eprints.whiterose.ac.uk/167907/3/84-2428-1-PB.pdf

[11] Canada Green Building Council 2021. Decarbonizing Canada's Large Buildings: Summary Report. Ottwa; https://www.cagbc.org/decarbonize: Eco Canada. (2021) Assessment of Occupational and Skills Needs and Gaps for the Energy Efficient Workforce. February. Calgary. https://www.caba.org/wp-content/uploads/2021/10/IS-2021- 205.pdf.

process.[12] Achieving low carbon building outputs is dependent, critically, on the knowledge, skills and competencies of those who actually do the work on building sites. There is an implicit assumption in much of the discussion of lowering the climate profile of buildings that if the other 'players' carry out their functions effectively, net zero carbon goals will be successfully implemented based on current training standards and working practices. This ignores the critical importance of the knowledge, skills and competencies required to carry out low carbon work properly. It is as if the people who actually do the work are not part of the solution.[13]

To be fair, this criticism does not apply to proponents of 'green' construction who are directly involved in the construction sector and who are aware of the importance of the work of the trades. However, their understanding about the critical role of the trades is not customarily part of the broader discussion of addressing global warming in buildings by climate advocates.[14] The policy recommendations of the latter are too often characterized by vague generalizations about the potential of the building sector to reduce energy use and GHG emissions with little concrete discussion of what this actually means for the work carried out on building sites or the role of the building trades themselves in meeting the climate challenge.

A parallel assumption is that the trades' training system as currently organized has the capacity to deliver a trades' workforce that is aware of the role it can play in addressing climate objectives and committed to achieving these objectives. While the current system generally has the capacity to provide apprentices and working trades with the specific skills required for the practice of their trades, it does not provide them with a broader understanding of climate science or the potential role of the construction industry in addressing climate issues. Canada's apprenticeship system has evolved in response to industry demands for a workforce that can deliver the kinds of construction projects traditionally required in a pre-climate change environment where energy conservation and environmental objectives were largely viewed as externalities, subordinate to the principal goal of keeping costs down and completing projects on budget and on time to win bids and avoid late penalties, an approach reinforced by the prevailing 'low bid'

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[12] The major exception is the work of organizations dedicated to promoting climate focused workforce training such as the Canada Green Building Council and Passive House Canada, Workforce 2030, Eco Canada and others with a specific focus on the labour and training/apprenticeship requirements of low carbon construction.

[13] For example, in the 2016 Pan Canadian Framework on Clean Growth and Climate Change which lays out the priorities of the Federal Government, the provinces and the territories, there is no mention of support for apprenticeship and only one sentence that mentions training in the main section and only one province even mentions training as part of its commitment. This is not to ignore the fact that governments continue to provide significant funding for apprenticeship programs. But the point is that they are not integrating this comprehensively into their climate strategies.

[14] The Federal Government announced in July, 2021 that it intends to lower Canada's GHG

emissions by between 40% and 45% by 2030. But this has not been accompanied by the level of training investment that would make this extremely ambitious target even potentially feasible. Retrofitting a significant part of the existing building stock of almost 10 million residences and half a million commercial and industrial buildings in 8 years would require a dramatic increase in the workforce and an enormous investment in the apprenticeship and training system to achieve this. So far this has not happened. This contrasts, for example, with the EU's focus on expanding its training system as reflected in the recent proposals for updating the Energy Performance of Buildings Directive or its multi-pronged strategy for meeting its 2030 climate objectives through Build Up Skills and other initiatives. See: European Commission. (2019) The European Green Deal. Dec. 11. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en. European Commission. (2021) Proposal for a Directive of the European Parliament and of the Council on Energy Efficiency. Brussels. July 14. https://ec.europa.eu/info/news/commission-proposes- new-energy-efficiency-directive-2021-jul-14_en . European Commission (2021) 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality Brussels. July 14. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0550&from=EN

approach to commissioning. This was compounded by the fact that long term energy and maintenance costs of building owners were not high priorities compared with the immediate costs of construction.

The lack of focus on climate issues is reflected in the current Red Seal Standards which provide the template for the curriculum apprentices must master to qualify as journey persons in each trade.[15] They do not mention climate change at all. While the Red Seal curriculum modules for a few trades do contain a limited number of references to sustainability and energy efficiency they do not link these to the wider objective of addressing climate change. Rather they focus narrowly on how apprentices need to learn the specific skills required to implement certain technologies or building systems such as LEED, BOMA- BESt or R-2000. Thus far, there has been no significant move to introduce climate science into the Red Seal Curriculum or to provide apprentices with an understanding of the potential of the building industry – and their work - to address global warming. The primary focus of the training remains one of teaching a package of skills necessary for the traditional practice of the trade.

Consequently, there is little need for the construction workforce to learn the reasons why low carbon or net-zero energy buildings are important in addressing climate change or the critical role the trades can play in ensuring that new and retrofitted buildings meet this objective. Rather, it is assumed that those who commission buildings, the professionals who develop building specifications and the contractors who employ the trades will provide the direction the workforce requires to see that low carbon construction is carried out effectively, supplemented by the increasingly stringent requirements of the building and energy codes.

One reason why there has been so little interest about introducing climate science into the trades' curriculum is that many in the climate policy community are not familiar with the details of the work of the skilled trades in the construction sector. Their knowledge of the apprenticeship system and the training involved in becoming a qualified Red Seal certified trades' worker is limited and largely outside their knowledge base. Their focus is on 'big picture' climate issues. How work actually gets performed on building sites is not their major interest – they assume that if a project is properly planned and the specifications are appropriate, the work will be done properly. This partially explains why there has been so little attention in much of the climate literature about the actual contribution of the construction workforce, the attitudes and motivations of construction workers or the value of creating a climate literate workplace culture in which all those working on site share a commitment to low carbon construction goals.

This might not matter if the current system was delivering environmentally sound construction practices. However, only 1% of Canada's building stock meets the Nearly Zero Ready building standard, a fact that underscores how much work still needs to be done to achieve Canada's climate objectives.[16] Numerous environmental organizations, backed up by solid research have raised concerns about the enormous gap between Canada's Paris commitments and the actual progress being made in reducing emissions and

[15] The Red Seal Standards are posted on the organization's web site at: https://www.red-seal.ca/about/pr.4gr.1m- eng.html.

[16] Lockhart and Haley. (2020) op. cit. The authors argue that strengthening building and energy codes is a critical policy option for governments to address the lack of progress to date on Net Zero Energy Ready (NZEr) buildings: "In Canada, as in the U.S., less than 1% of buildings currently constructed are considered NZEr.13 However, each iteration of the model codes development cycle has the potential to spur the advancement of innovative products, technologies, processes, and practices." p. 12.

energy use. [17]Developers continue to build as they have in the past doing only what they are legally required to do by the relevant building and energy codes.

But the issue is not only that there is insufficient demand for low carbon buildings. It is also that many of the buildings that are promoted as low carbon fail to achieve their promise. There is an extensive literature, much of it substantiated by the European Union's Build Up Skills initiatives, that documents a substantial 'performance gap' in low energy construction.[18] This is the gap between the plans and specifications of sustainable buildings, or retrofits, and the actual energy performance of these buildings once completed. There is considerable evidence that many buildings that are designed to achieve near zero energy performance standards fail to do so because they are not properly built. In some cases, post construction assessments have found that newly constructed 'energy efficient' or LEED rated buildings actually perform no better than conventional structures.[19]

There are a variety of factors that contribute to the performance gap.[20] It can result from oversights in building plans, poorly written or inadequate specification details, use of inappropriate materials and/or unauthorized substitutions and failure to monitor and assess building performance once construction is completed. It can also result from contractors cutting corners when they know that their work is unlikely to be inspected and the energy profile of the building will not be measured after completion. Extensive sub-contracting practices may dilute responsibility for the overall outcome of a building project.

There has been innovation and an interest in new technologies. However, the industry has yet to ensure that the workforce has the opportunity to acquire the relevant knowledge, skills and competencies needed for low carbon construction. And this is because there is insufficient understanding that effective low carbon construction requires a different approach to the building process – an approach which focuses on quality of installation and treating buildings as integrated systems in which every component must be built properly for the final product to meet its climate objectives. [21]

While the trades do not control many of the preceding factors that contribute to the performance gap, a recognition of their support for effective low carbon construction practices can be a significant factor in reducing the extent of the gap. The quality of the work the trades perform on building sites is an essential

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[17] Climate Action Network. (2021) Getting Real About Canada's Climate Plan. Greenpeace, Equiterre et. al. https://climateactionnetwork.ca/wp-content/uploads/2019/06/CAN-RAC_ClimatePlanExpectations_EN-1.pdf

[18] Zero Carbon Hub (2014) Closing the Gap Between Design and As Built Performance: Evidence Review Report. London: March. (this is one of a series of Zero Carbon Hub studies with the same name but focusing on different aspects of the performance gap and published the same year.) www.zerocarbonhub.org/

[19] De Wilde, Pieter. (2014) The Gap Between Predicted and Measured Energy Performance of

Buildings: A Framework for Investigation. Automation in Construction. Vol, 41, May; Cali, Davide, Tanja Osterhage, et. al. (2016) Energy Performance Gap in Refurbished German Dwellings: Lessons Learned from a Field Test. Energy and Buildings. Vol 127, 1146 – 1158; Zou Patrick, Xiaoxiao Xu et. al.(2018). Review of 10 Years research on Building Energy Performance Gap: Life Cycle and Stakeholder Perspectives. Energy and Buildings. Vol. 178. pp. 165 – 181. International Partnerships for Energy Efficient Cooperation. (2019) Building Energy Performance Gap Issues. IPECC Building Energy Efficient Taskgroup. November. https://www.energy.gov.au/sites/default/files/the_building_energy_performance_gap-an_international_review- december_2019.pdf; De Wilde, Pieter (2021) Performance Gaps: A Commentary. Academia Letters. March 2021. https://www.academia.edu/45611580/Building_Performance_Gaps_a_Commentary.

[20] Darko, Amos and Albert Chan. (2017) Review of Barriers to Green Building Adoption. Sustainable Development. Vol. 25, pp. 167 – 179.

[21] Clarke, Linda., Gleeson, Colin, Christopher Winch and F. Duran-Palma. (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

component of sound low carbon construction practices. [22] But for this to be achieved, the training system, both for apprentices and for skilled trades' upgrading, must provide them with knowledge about the broader climate rationale underlying efforts to reduce GHG emissions. It must include information about the contribution buildings can make to achieving this goal. And it must include appropriate training on low carbon construction methods, including the corresponding competencies needed to implement these methods, as well as an understanding of the significance of their work in fighting climate change .[23]

As noted above, a fundamental weakness of the current training system is its almost exclusive emphasis on providing the trades' workforce with narrowly focused, trade specific skills. The fundamentals of both climate science and building science receive too little attention. Of course, knowledge of how to exercise the range of specific skills needed carry out various components of the work of each trade is important and provides a foundation for quality construction work. These skills are necessary for effective low carbon construction. But in the context of the climate emergency, this must be supplemented by a focus on 'why' implementing low carbon construction methods is now so important and why this work must be done properly – and to a high standard - if it is to achieve climate goals. It is the 'why' that is missing from the current training system.

Improving the quality of construction work is essential to ensure that that climate objectives are fully realized. This is because low carbon construction requires particularly careful attention to building plans and specifications and much more precise quality control.[24] Practices that are acceptable in conventional construction, where energy conservation is not a primary objective, are unsuited to achieving stringent climate objectives. Low carbon construction also requires an integrated approach in which the components of a building are viewed in a wholistic way. Failure to ensure that all elements of a project fulfil their climate objectives can seriously compromise its energy performance. For example, the importance of thermal bridging must be understood by all trades working on a site to ensure that they do not compromise the building envelope in carrying out their respective tasks. Plumbers must ensure that the pipes they lay have room for the appropriate thickness of mechanical insulation. HVAC systems must be properly insulated even where much of the piping and ductwork is hidden behind interior walls and invisible to future building owners. [25] And so forth.

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[22] Gleeson, Colin (2016). "Residential heat pump installations: the role of vocational education and training." Building Research & Information. Vol. 44.Issue 4. Sept. 11. http://www.tandfonline.com/doi/full/10.1080/09613218.2015.1082701. In comparing the success of heat pump installations in Germany and the UK, Gleeson found that the principal factor for the much lower performance of UK installations was the lack of training of the workforce. This was true even though they were installing the same equipment by the same manufacturers.

[23] Clarke, Linda, Melahat Sahin-Dikmen and Christopher Winch. (2020) Overcoming Diverse

Approaches to Vocational Education and Training to Combat Climate Change: The Case of Low Energy Construction in Europe. Oxford Review of Education. June 12. https://doi.org/10.1080/03054985.2020.1745167:

[24] Zero Carbon Hub. op. cit.; Killip Gavin, Alice Owen et. al. (2019); Exploring the Practices and Roles of UK Construction Manufacturers and Merchants in Relation to Housing Energy Retrofit. Journal of Cleaner Production. Nov. 11. Topouzi, Marina, Gavin Killip et. al. (2019) Deep Retrofit Approaches: Managing Risks to Minimize the Energy Performance Gap. ECEEE Summer Study Program: Make Building Policies Great Again. https://eprints.whiterose.ac.uk/143558/7/7-349-19_Topouzi.pdf

[25] HB Lanarc (2010). "Pipes Need Jackets, Too: Improving the Performance of BC Buildings Through Mechanical Insulation Practice and Standards – A White Paper." Vancouver: http://www.mechanicalinsulators.com/research.htm.

Numerous recent studies have emphasized the preceding points. Typical is a statement from a recent Canada Green Building Council report outlining changes needed to enable Canada's building industry to meet climate objectives:

"However, one of the main findings of this report is that technical skills alone will not satisfy the requirements of low-carbon buildings. Changes to the larger construction approach and acknowledgment of soft skills are necessary to deliver high-performing buildings. We therefore need to increase overall levels of "green literacy" or said another way, the ability to understand the broad implications of key building activities on the environment and the market infrastructure. This works in concert with changes to the way construction projects are undertaken. The threshold for mistakes in high-performing buildings is slim and demands a higher level of sophistication and precision for the entire project team. The trades are extremely important for achieving high-performing buildings, but they need the support of the remaining construction ecosystem to succeed." [26]

Much current construction is characterized by a fragmented approach to organizing the work, based on extensive subcontracting and relatively limited coordination and cooperation among the various contractors and trades working on building sites. Everyone is doing their 'own thing' to fulfil the specifications of their individual contracts as cheaply and quickly as possible. Low bid is the norm and too often cost cutting takes presence over quality. As a recent paper by Eco Canada notes: "Traditional approaches to procurement include a "design-bid-build" structure, which sequences the work through separate contracts for design and construction. This approach to procurement is incompatible with integrated approaches to planning and construction that are effective for developing or retrofitting energy efficient buildings.[27]"

The result is that no one is responsible for the overall climate performance of the building, a problem exacerbated by the lack of post construction measurement of building performance. Gaps between the various contract silos are not filled in. Energy losses are no one's responsibility. It is a system that is not conducive to realizing climate objectives.

Most contractors remain committed to the traditional approach, one reinforced by the economics of the industry. Regardless of their personal views on climate change, their economic interest is to deliver the minimum that will be required to meet the specifications in the tenders they win, even if they know that certain practices do not achieve the full potential of energy efficiency and low GHG emissions. Similarly, while developers increasingly promote certain aspects of their buildings as 'green' and often advertise their LEED environmental credentials, one does not need to be overly cynical to realize that too many claims for environmentally responsible construction are basically vehicles for marketing purposes. [28]

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[26] Canada Green Building Council. (2019). Trading Up: Equipping Ontario Trades with the Skills of the Future. Ottawa. p.6. https://www.cagbc.org/tradingup. Eco Canada. (2021) Assessment of Occupational and Skills Needs and Gaps for the Energy Efficient Workforce. February. Calgary. https://www.caba.org/wp- content/uploads/2021/10/IS-2021-205.pdf

[27] Eco Canada. (2021) Assessment of Occupational and Skills Needs and Gaps for the Energy Efficient Workforce. February. Calgary. P. 18. https://www.caba.org/wp-content/uploads/2021/10/IS-2021-205.pdf

[28] LEED has also been criticized because it is possible to obtain a high rating despite having relatively poor energy performance. This is because points are given for a variety of aspects of a project which can add up to an overall score which looks quite good, even if energy related aspects are poorly rated. Orr, Robert, (2014) The Problems with LEED. Project For Lean Urbanism: Centre for Applied Transect Studies. https://leanurbanism.org/wp-content/uploads/2014/06/Orr-LEED.pdf. Ade, Rochelle and Michael Rehm. (2020 The Unwritten History of Green Building Rating Tools: A Personal View from Some of the 'Founding Fathers' (2020). Building Research and

It is also notable that in revising Canada's national building and energy codes, there was considerable resistance from parts of the industry who were concerned about the additional cost, administrative requirements and training burden that more stringent codes would have on their operations. Much of the conflict was over whether to use a reference-based approach, which was adopted, and an outcome-based approach which provides clearer measurement standards for building energy use and is arguably a more effective way to lower building energy use.[29]

This assessment of the industry may seem a bit harsh given that there is considerable public discussion about how Canada is committed to ensuring the construction industry plays its role in the country's climate agenda. And it seems at odds with the claims of many in the industry that they are now strongly committed to low carbon construction. To be fair, there are significant pockets of effective 'green' construction, such as those promoted by Passive House and the industry members of the Canada Green Building Council. LEED has also become more prevalent in the industry and, if the energy conservation and related elements of the rating system are fully implemented, can be an important lever for encouraging higher building energy standards. Some of Canada's largest construction firms have also made significant efforts to introduce climate objectives into their operations They are 'talking the talk' and making efforts to walk the walk. But the mainstream industry remains focused on minimizing costs, an objective promoted, as noted, by the prevailing practice of low bid contract tendering. It is also reluctant to accept the kind of detailed energy performance monitoring that is clearly needed to ensure new buildings and retrofits meet stringent climate standards.

To achieve successful low carbon construction, the workforce must have a deeper understanding of building science. The trades' curriculum and on-site working practices must view building projects from a 'whole building' perspective, rather than a collection of siloed contracts.[30] This means that every component must be properly integrated with all the others. It also requires a strong commitment by everyone in the supply chain – developers, architects, engineers, planners, contractors and, most importantly, the skilled trades - to supporting workplace practices and norms that prioritize meeting low carbon objectives. In short, effective low carbon construction requires a significant cultural change in the industry at all levels, but particularly on the organization of work on building sites. [31]

So what difference could a more climate literate construction workforce make to achieving Canada's climate objectives? Why should we care whether the trades' training system provides apprentices with an

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Information. Vol. 48, No. 1. pp. 1 – 17; Castro, Danielle and Amy Kim. (2021) Adaptive or Absent: A Critical Review of Building System Resilience in the LEED Rating System. Sustainability. Vol. 13, (12). June 12. https://www.mdpi.com/2071-1050/13/12/6697/htm.

[29] Lockhart and Haley, op. cit.; Bernhardt, Robert, (2021). The Reference Building Approach. Passivehouse Canada Policy Series No. 5. https://www.passivehousecanada.com/policy-series-

5-the-reference-building-approach/

[30] Build-Up Skills (2015). "Greening of the Building Sector is Held Back by Skill Shortages: Skills Led Strategies Can Drive Green Building Forward." Geneva; European Union and International Labour Organization. http://www.buildupskills.eu/resources/building-workforce-and-skills. Canada Green Building Council. (2019). Trading Up: Equipping Ontario Trades with the Skills of the Future. Ottawa. https://www.cagbc.org/tradingup; Canada Green Building Council. (2020) Trading Up: How Alberta's Trades Can Build a Zero Carbon Future. Ottawa. https://www.cagbc.org/CAGBC/Advocacy/trading_up.aspx.

[31] Clarke and Gleeson (2017) op. cit.: Clarke, L., Gleeson, C., et. al. (2019) Inclusive Vocational Education and Training for Low Energy Construction (VET4LEC) (Final Report) https://www.fiec.eu/our-projects/completed- projetcs/vet4lec.Clarke, Linda, Melahat Sahin-Dikmen and Christopher Winch. Transforming Vocational Education and Training for Nearly Zero Energy Building. (2020). Building and Cities. pp. 650 – 661.

understanding of climate change and the importance of net zero buildings in contributing to achieving effective mitigation?

First, the skilled trades are the people who perform most of the work on construction sites. It is their work that is essential for achieving high quality, climate appropriate outcomes. If they are not performing their work properly - for whatever reason – and, consequently, not meeting low carbon objectives effectively, projects will not achieve design goals. [32]As earlier noted, the many skills currently exercised by the skilled trades are precisely the skills that are necessary for effective low carbon construction. The basic skills of electricians, plumbers, carpenters, ironworkers, finishing trades and others are - and will remain - essential to achieving effective low carbon construction objectives. These are skills learned through a demanding apprenticeship system as well as subsequent on-the-job experience as qualified trades' practitioners. Effective low carbon construction requires a workforce with these skills. But it also requires a workforce that understands how these skills can ensure successful low carbon construction and, critically, why this is important. Understanding the key role that their work can play in meeting climate objectives is key to implementing low carbon construction.

Second, in addition to having the relevant skills, the commitment of the trades' workforce to achieving climate objectives is vital. They can - and should - be active participants in achieving these objectives. They are the people who do the work on building sites. Most construction workers have pride in doing a job well. Knowledge of the connection of their work to addressing climate change can be a significant motivator to doing work properly. Knowing why work must be done to a particular standard, and hence its significance in reducing our climate footprint, reinforces the importance of doing it right. It can also encourage workers to follow the best working practices and in some cases provide a rationale for resisting pressure from contractors to cut corners.

At almost every stage of the construction process there are choices which impact whether a project fulfils its climate objectives. Many of these choices are made by the trades in performing their jobs. Most trades carry out their assignments with relatively little supervision because the industry recognizes that they are qualified to do the work and know what needs to be done. How well they handle these choices depends partly on their skills, competencies and experience. But it also depends on their attitudes, values and motivations as well as the broader culture of the workplace. Where trades understand and support the climate objectives of a project, they can choose to perform their work in a way that advances the climate agenda. Conversely, if the importance of meeting these objectives is not well understood and they are under pressure to cut corners and meet pressing deadlines, they may choose less optimal options.[33]

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[32] Ewart Keep makes this point forcefully in his review of factors shaping the development and effective exercise of skills in the UK: "Research shows that a great deal of innovation within organisations in all sectors (public and private) occurs at or very close to the productive process itself. It is concerned with 'shop floor' or front-line staff being able (i.e. empowered and sufficiently skilled) and willing to make incremental adjustments in the quality, specification,

design and/or utility of the good or service that is being delivered, or within the productive process through which the good or service is delivered, in order to improve productivity or quality." Keep, Ewart. (2016) Improving Skills Utilization in the UK – Some Reflections on What, Who and How. SCOPE - Oxford University Department of Education. https://ora.ox.ac.uk/objects/uuid:fac4684f-7de8-408d-bac0-b6b767a38479/download_file?file_format=pdf&safe_filename=Keep%2B%25282016%2529.%2BImproving%2BS kills%2BUtilisation%2Bin%2Bthe%2BUK-%2BSome%2Breflections%2Bon%2BWhat%252C%2BWho%2Band%2BHow.pdf&type_of_work=Report

33 This analysis calls into question the assumption that much of the work on low carbon projects can be handled by a workforce with little or no formal construction training. There are numerous short, 'micro-credential' courses being offered which advertise to prospective students that they can be proficient in one area of 'green' construction after a short training period and that this is a pathway to permanent employment. Aside from the inherent vulnerability of

Third, the building trades play a major role in ensuring that the building and energy codes are properly implemented. They are the ones who know whether codes are being followed. They have considerable capacity to ensure that site practices do not circumvent the codes. Understanding the rationale for the increasingly stringent codes is important because it means the trades do not view the codes as simply another regulatory burden that increases their work, but rather as a way to ensure that all buildings meet society's climate objectives. Following the codes means doing the job right. Knowledge of the value of the codes also provides an incentive for continuous upgrading of the skills required to implement codes.

Fourth, numerous studies of successful low carbon construction emphasize the importance of effective cooperation and consultation among all trades, as well as others who contribute to the building process, including architects, engineers and those who commission the work. Success is contingent on all parties contributing to – and being responsible for - the overall outcome. This means not only completing each separate contract or sub-contract on time and on budget, but ensuring that they all fit together seamlessly. It also means that each trade needs to be mindful of how careless work can negate the contribution of other trades. A commitment to climate literacy incorporates this perspective and encourages workers to collaborate in ensuring the overall project is built properly.

Fifth, the trades can contribute to creating a workplace culture that supports climate objectives. White collar professionals need to respect the knowledge and role of the builders. As noted, successful low carbon or net zero construction requires effective cooperation among all those involved in a construction project from those who commission the project in the first place to developers, architects, engineers, contractors and the trades themselves. Having a trades workforce that understands and supports efforts to lower the carbon footprint of buildings can contribute positively to the development of this workplace culture. Being part of a positive workplace culture makes it much easier to adopt the best practices needed for effective low carbon construction. This includes treating everyone with respect. Anyone familiar with the construction workplace know that while teamwork is valued, it is not always fostered among and between crews. That negativity can undermine efforts to cultivate best practices for achieving high performance buildings. A workplace that is characterized by sexism, racism and a culture of bullying is not likely to facilitate the kind of cooperation that is essential for effective low carbon construction.

Sixth, while discussions of implementing low carbon construction focus disproportionately on new buildings, these represent only a small portion of the energy conservation and GHG emissions potential of the built environment. To meet its stated climate objectives, Canada will have to support a massive retrofitting of residential, commercial and industrial buildings.[34] In its 2018 report, the Senate of Canada noted that three quarters of the buildings in place at that date would still be in use in 2030.[35] While larger projects normally have the support of architects and engineers to develop the retrofit plans, smaller projects normally do not involve these professionals. Consequently, building owners rely extensively on the knowledge and skills of the trades for advice on how to reduce the climate footprint of their structures.

being confined to a narrow area of work, this approach ignores many of the fundamental challenges associated with construction work, including health and safety requirements, competencies in math, reading drawings, use of equipment and numerous other factors. And it reflects a narrow, Taylorist assumption that ignores the importance of providing decent work that includes opportunities for agency, personal development and pride in solving the many problems that regularly occur on building sites. For a good discussion of these issues see: Killip, Gavin. (2020) A Reform Agenda for UK Construction Education and Practice. Buildings and Cities. Aug 24, Vol. 1. pp. 525 – 537. [34] Frappe-Seneclauze. (2020) Achieving Canada's Climate and Housing Goals Through Building Retrofits. Pembina Institute. April. https://www.pembina.org/reports/federal-buildings-recs-2020.pdf. Kennedy, Madi and Tom-Pierre Frappe-Seneclauze. (2021) Canada's Renovation Wave: A Plan for Jobs and Climate. Pembina Institute. July https://www.pembina.org/pub/canadas-renovation-wave.
[35] Senate Standing Committee. Op Cit.

The ability of the trades to provide this advice is contingent on their knowledge of low carbon construction principles and their understanding of – and support for - the climate science rationale for retrofitting buildings.

The preceding is not to ignore that what the trades do is largely determined by contract specifications building code regulations and the directions they receive from their employers or the contracts they sign. However, the skilled trades still have considerable discretion about how they practice their trade on building sites. They exercise control over the quality of their output and hence whether the work is done well or simply to a minimum standard. While the trades, like other workers, want steady employment and a good pay cheque, they also take pride in the competent exercise of their skills and ensuring that a job is well done. To the extent that achieving climate objectives is part of doing a job properly, this can make a substantial difference in whether low carbon objectives are achieved. Attitudes and values do make a difference.

Appendix 7

How Well Do the Red Seal Apprenticeship Guidelines for the Construction Trades Incorporate Canada's Climate Change Commitments?

John Calvert

Canada's Red Seal Standards are based on the National Occupational Analyses (NOA) system. The Standards identify the knowledge and skills that apprentices must learn to pass their Red Seal examinations, enabling apprentices to be certified as qualified journeypersons in a specific trade. [1]The Red Seal documents outlining the Standards for each trade are quite comprehensive, normally including between 100 to 200 pages of detailed knowledge and skill requirements. These requirements become the basis for the curricula used in trades training programs in provinces and territories across Canada. These training programs are not confined to teaching to the Red Seal standard and can add additional learning resources depending on local and regional factors. But they must, at a minimum, include the Red Seal requirements.

Given its standard setting function, the Red Seal knowledge and skill guidelines provide an important signal to trades' trainers across the country about what should be included in their curricula. In light of Canada's growing concern about mitigating and adapting to climate change, the question of whether and, if so, to what extent, climate change issues are currently being covered in the Red Seal guidelines is of considerable interest. Buildings and related infrastructure account for about one third of GHG emissions and energy consumption, globally and about 15% in Canada due to the larger role of transportation and resource extraction in Canada's economy.

Lowering Canada's carbon footprint is a major objective of Canada's climate policies. Over the past three decades, both federal and provincial/territorial governments have been ratcheting up the requirements of their Building and Energy codes to enforce tougher GHG and energy targets. This trend will continue in the coming years as the Federal Government has announced that it plans to reduce Canada's GHG emissions by between 40% and 45% by 2030[2]. Accordingly, governments will be implementing tougher standards in the construction industry in the coming years.

To meet these objectives, the construction industry will have to implement low carbon, or near zero carbon outcomes in the buildings and related infrastructure it produces. While a variety of

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[1] The Pdf files of the various Red Seal Trades are posted on its web site. http://www.red- seal.ca/resources/wh.1t.3sn.4.1-eng.html

[2] Environment and Climate Change Canada. (2020) A Healthy Environment and a Healthy Economy. Ottawa: https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview/healthy- environment-healthy-economy.html;
Canada (2021) Bill C-12, An Act Respecting Transparency and Accountability in Canada's Efforts to Achieve Net Zero Greenhouse Gas Emissions by the year 2050. Ottawa, June 29; https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/net-zero-emissions-2050/canadian- net-zero-emissions-accountability-act.html ;

Environment and Climate Change Canada. (2020) Canada's Greenhouse Gas and Air Pollutant Emissions Projections 2020. Ottawa: https://publications.gc.ca/site/eng/9.866115/publication.html

professionals – architects, engineers, planners, building scientists and developers – will play a major role in this process, much of the actual work will be done by the qualified trades' workforce. It is trades' workers who will have the responsibility of ensuring that the industry's efforts to reduce its carbon footprint is properly implemented. And this will require a strong commitment to carrying out effective low carbon construction methods on building sites. It will require a 'climate and energy literate' workforce.

A key factor that can contribute to the development of climate/energy literacy is the way in which the workforce is trained. Incorporation of climate awareness into the content of the curriculum in the classroom and in the practical, hands-on experience construction workers have on building sites will play an important role in this process. It can give the workforce knowledge about climate science and the reasons why low carbon construction is now so important. It can also provide the trades' workforce with the skills required to implement it on construction projects.

However, a logical starting point is to examine what is now being taught about climate change issues in Canada's current trades training programs. The focus of this short paper is to examine the extent to which Canada's current training and apprenticeship system promotes an awareness of the contribution the construction industry can make to meeting our climate goals by examining the extent to which the issue is being incorporated into the apprenticeship curriculum, both in the classroom and on job sites.

One way to assess how well Canada is preparing its construction workforce for low carbon, or near zero construction working practices is to examine the frequency with which climate change terminology is included in the text of the Red Seal occupational guidelines. These guidelines set out the knowledge and skills apprentices must master to obtain their Red Seal ticket as a fully qualified trades' worker. Analysing the use of climate terminology is only one measure for evaluating the extent to which climate issues are covered in the apprenticeship programs. It needs to be used cautiously as it does not necessarily reflect what Canada's trades instructors are teaching in the classroom component of their trades' programs. Nor does it necessarily reflect what apprentices are learning in the on-the-job component of their training program. But it does provide one indicator of the extent to which climate change issues are being covered in the training apprentices receive.

To do this we have identified key climate related terms and then carried out a word search in the text of the Red Seal Standards Pdf documents which outline the knowledge and skills required for each trade. These are posted for all apprentices to download for guidance about what they need to know to pass their exam. In several cases we also reviewed the actual classroom curricula for a trade using the same word searches to see if there was any significant difference.

Of course, using a word search is admittedly a rather simple and perhaps rather crude indicator. In using this approach, we are not claiming that the methodology captures the many ways in which climate issues are now being incorporated into the work of Canada's building trades. But it does provide some insight about the extent to which climate science is now affecting what the trades' workforce is expected to know.

A significant number of terms can reflect climate objectives. Choosing the right ones is, admittedly, somewhat arbitrary. But some of the most common can be readily identified and others

that have some relationship to dealing with climate issues can also be noted based on the content of the documents being surveyed. This analysis has been carried out using the following terms: Climate Change, Global Warming, LEED, Energy Star, Low Carbon Construction, Environment (as related to sustainability) Energy Conservation, Renewable Energy, ASHRAE, Green House Gas, Green Energy, Emissions (reducing), Energy Efficiency, Green energy & Green, Construction, Sustainability, Eco Friendly and Net Zero. Undoubtedly, we might have added other climate related terms might to this list. But for the purpose of obtaining an overview of the extent to which climate change is being included in the Red Seal requirements, the terms identified arguably provide a reasonable, if not exhaustive, sample.

For the purpose of this analysis, we selected 32 construction, or construction related, trades. The sample includes some small trades and some that overlap with skills outside the core construction sector, but we felt we should be as comprehensive as possible. We then carried out a word search for each of the above noted climate related terms to see the extent to which climate issues were being identified in Pdfs of the Red Seal documents. Some of the terms, such as environment required interpreting in the context in which they were being used. Most uses referred to working environment, which was distinguished from the use of the term in relation to climate change. In some cases, the use was ambiguous, so we normally included the reference in the count for climate related terms. But this was essentially a judgement call on our part.

In the following tables, we have summarized the key findings of our word search for each of the 32 trades. As a quick review of the data on the first table will reveal, climate change is not referenced even once in the Red Seal pdfs. Nor is global warming mentioned. However, some other climate related terms are used occasionally - and in several cases - more frequently, including the terms LEED, environmental protection, renewable energy, ASHRAE and energy efficiency. References to climate related terms tend to be clustered in a few trades, with other trades having very few such terms. Many of the climate related references that we found are also directly connected with describing a particular skill or piece of knowledge such as skills required to build a LEED building or install a piece of equipment such as solar panels, wind farm components or electric charging stations.

A further examination of the pdfs indicates that there is almost nothing that deals with the broader science of climate change or the consensus in the scientific community that climate change poses what is perhaps the most important threat to our civilization that our species has ever faced. Similarly, while there are references to the importance of meeting building and energy code requirements, the underlying rationale behind government efforts to promote low carbon construction is not articulated. What emerges from this survey is that explicit references to the science on which climate change polices are based is not being included in the terms used in the discussion of knowledge and skills included in the Red Seal documents.

Below is the first of four tables that summarize our 2019 word search. It lists the frequency that 5 key terms associated with climate change: climate change, global warming, Leadership in Energy and Environmental Design (LEED), Energy Star and Low Carbon Construction mentioned in the Red Seal Pdfs for the 32 trades surveyed. As the table indicates, the most relevant climate

term used is LEED which reflects the use of this approach by architects and designers of certain types of low energy buildings and hence the need for apprentices to be knowledgeable about this construction technique.

References to Climate Change Terms in Red Seal Templates for Construction Trades (1)

Occupation	Climate Change	Global Warming	LEED	Energy Star	Low Carbon Construction
Boilermaker RSOS 2016	0	0	0	0	0
Boilermaker Curriculum 2016	0	0	0	0	0
Bricklayer 2016	0	0	3	0	0
Cabinetmaker 2012	0	0	0	0	0
Carpenter 2013	0	0	0	0	0
Concrete Finisher (RSOS) 2017	0	0	0	0	0
Construction Craft Worker (NOA) 2015	0	0	2	0	0
Construction Electrician (RSOS) 2015	0	0	2	0	0
Construction Electrician (Curriculum) 2015	0	0	2	0	0
Drywall Finisher and Plasterer 2013	0	0	2	0	0
Gasfitter--Class A 2014	0	0	5	0	0
Gasfitter--Class B 2014	0	0	5	0	0
Glazier 2012	0	0	3	1	0
Heavy Equipment Operator (Dozer) 2015	0	0	0	0	0
Heavy Equipment Operator (Excavator) 2015	0	0	0	0	0
Heavy Equipment Operator (Tractor-Loader-Backhoe) 2015	0	0	0	0	0
Industrial Electrician (RSOS) RSOS 2016	0	0	0	0	0
Industrial Electrician (Curriculum) 2016	0	0	0	0	0
Insulator (Heating and Frost) 2018	0	0	2	0	0
Ironworker (Generalist) 2015	0	0	0	0	0
Ironworker (Reinforcing) 2015	0	0	0	0	0
Ironworker (Structural/Ornamental) 2015	0	0	0	0	0
Metal Fabricator (Fitter) 2012	0	0	0	0	0
Mobile Crane Operator 2013	0	0	0	0	0
Oil Heat System Technician 2015	0	0	0	0	0
Painter and Decorator 2011	0	0	0	0	0
Plumber (RSOS) 2016	0	0	1	1	0
Plumber (Curriculum) 2016	0	0	1	1	0
Powerline Technician 2013	0	0	0	0	0
Roofer 2012	0	0	4	0	cut carbon footprint 1
Sheet Metal Worker 2018	0	0	5	0	0
Sprinkler System Installer [NOT FOUND]					
Steamfitter/Pipefitter (RSOS) 2015	0	0	4	0	0
Steamfitter/Pipefitter (Curriculum) 2015	0	0	3	0	0
Tilesetter 2010	0	0	4	0	0
Tower Crane Operator 2012	0	0	0	0	0
Welder 2014	0	0	0	0	0
TOTALS	**0**	**0**	**48**	**3**	**1**

Note: Year refers to the year the Red Seal Standard was last revised

Note: the dates shown are the most recent Red Seal available on its website, on May 11, 2021 the day the survey was completed

The term environment is used fairly extensively in the Red Seal Pdfs. However, in most cases it does not refer to climate change. The principal meaning relates to ‘working environment’, which includes matters such as health and safety provisions, shop environment, environmental regulations, supervision/team environment, appropriate facilities/equipment and so forth. Sometimes it refers to the environment in the context of avoiding pollution, toxic chemicals and managing waste properly. It also can refer to the impact of weather on the job. And it sometimes refers to the concept of learning environment. In a small minority of cases the term is used to refer to climate change.

To give a concrete example, in the 214 page Pdf for Construction Electrician, the 72 references to various environment-related issues is broken down as follows: harm/impact on the environment - 40; installation environment -11; safety and environment- 7; work environment -4; environmental factors -3, environmental damage -3, LEED – 2; environment friendly - 1,.The largest category, harm/impact on the environment refers almost exclusively to the environment directly around the job site. A similar pattern emerges with other trades, with references to the environment making no explicit reference to climate change issues or the contribution the work can make to lowering GHG emissions or energy consumption.

The following table includes the extensive number of references to the term environment int the 32 Pdfs as well as those that have some connection with conservation or environmental protection. It also contains two columns, energy conservation and renewable energy that are more directly related to climate objectives. In the case of renewable energy, the references are largely about work on these kinds of projects but not about their link to meeting Canada’s climate objectives. The dates adjacent to the trade name is the latest version of the Red Seal requirements posted on its web site.

References to Climate Change Terms in Red Seal Templates for Construction Trades (2)

Occupation	Environment (total)	Environmental Protection/Sustainability	Energy Conservation	Renewable Energy
Boilermaker RSOS 2016	23	5	0	1
Boilermaker Curriculum 2016	15	1	0	1
Bricklayer 2016	22	10	0	0
Cabinetmaker 2012	18	4	0	0
Carpenter 2013	19	10	0	1
Concrete Finisher (RSOS) 2017	13	2	0	0
Construction Craft Worker (NOA) 2015	28	16	0	0
Construction Electrician (RSOS) 2015	72	50	0	53
Construction Electrician (Curriculum) 2015	16	4	0	40
Drywall Finisher and Plasterer 2013	11	5	0	0
Gasfitter--Class A 2014	18	12	2	0
Gasfitter--Class B 2014	18	12	2	0
Glazier 2012	14	4	0	0
Heavy Equipment Operator (Dozer) 2015	22	11	0	0
Heavy Equipment Operator Excavator 2015	22	12	0	0
Heavy Equipment Operator (Tractor-Loader-Backhoe) 2015	21	11	0	0
Industrial Electrician (RSOS) RSOS 2016	64	13	0	48
Industrial Electrician (Curriculum) 2016	33	8	0	34
Insulator (Heating and Frost) 2018	27	9	1	0
Ironworker (Generalist) 2015	11	3	0	0
Ironworker (Reinforcing) 2015	9	3	0	0
Ironworker (Structural/Ornamental) 2015	9	1	0	0
Metal Fabricator (Fitter) 2012	10	3	0	0
Mobile Crane Operator 2013	11	2	0	0
Oil Heat System Technician 2015	16	10	0	0
Painter and Decorator 2011	23	12	0	0
Plumber (RSOS) 2016	22	11	0	0
Plumber (Curriculum) 2016	17	9	0	0
Powerline Technician 2013	30	24	0	0
Roofer 2012	25	8	1	0
Sheet Metal Worker2018	33	11	2	0
Sprinkler System Installer [NOT FOUND]				
Steamfitter/Pipefitter (RSOS) 2015	77	39	0	4
Steamfitter/Pipefitter (Curriculum) 2015	30	7	0	3
Tilesetter 2010	31	5	0	0
Tower Crane Operator 2012	14	4	0	0
Welder 2014	15	3	0	0
TOTALS	**848**	**386**	**8**	**185**

Note: Year refers to the year the Red Seal Standard was last revised
Note: the dates shown are the most recent Red Seal available on its web site, on May 11,2021 the day the survey was completed

References to Climate Change Terms in Red Seal Templates for Construction Trades (3)

Occupation	ASHRAE	Green House Gas (GHG)	Green Energy	Lower Emissions -	Energy Efficiency
Boilermaker RSOS 2016	0	0	1	1	0
Boilermaker Curriculum 2016	0	0	1	1	0
Bricklayer 2016	0	0	0	0	2
Cabinetmaker 2012	0	0	0	0	0
Carpenter 2013	0	0	0	0	6
Concrete Finisher (RSOS) 2017	0	0	0	0	0
Construction Craft Worker (NOA) 2015	0	0	0	0	0
Construction Electrician (RSOS) 2015	2	0	0	0	1
Construction Electrician (Curriculum) 2015	2	0	0	0	0
Drywall Finisher and Plasterer 2013	0	0	0	0	0
Gasfitter--Class A 2014	0	0	0	emissions specs 1	15
Gasfitter--Class B 2014	0	0	0	cut energy use 1	17
Glazier 2012	0	0	0	0	0
Heavy Equipment Operator (Dozer) 2015	0	0	0	emissions control 1	0
Heavy Equipment Operator (Excavator) 2015	0	0	0	emissions control 1	0
Heavy Equipment Operator (Tractor-Loader-Backhoe) 2015	0	0	0	emissions control 1	0
Industrial Electrician (RSOS) RSOS 2016	0	0	0	0	0
Industrial Electrician (Curriculum) 2016	1	0	0	0	0
Insulator (Heating and Frost) 2018	0	0	0	net zero target 1	0
Ironworker (Generalist) 2015	0	0	0	0	0
Ironworker (Reinforcing) 2015	0	0	0	0	0
Ironworker (Structural/Ornamental) 2015	0	0	0	0	0
Metal Fabricator (Fitter) 2012	0	0	0	0	0
Mobile Crane Operator 2013	0	0	0	0	0
Oil Heat System Technician 2015	0	0	0	0	0
Painter and Decorator 2011	0	0	0	0	0
Plumber (RSOS) 2016	0	0	0	0	1
Plumber (Curriculum) 2016	0	0	0	0	1
Powerline Technician 2013	0	0	0	0	efficient lighting 1
Roofer 2012	0	0	0	0	1
Sheet Metal Worker 2018	36	0	alt energy 1	0	System efficiency 16
Sprinkler System Installer [NOT FOUND]					
Steamfitter/Pipefitter (RSOS) 2015	0	0	0	0	1
Steamfitter/Pipefitter (Curriculum) 2015	0	0	0	0	1
Tilesetter 2016	0	0	0	0	0
Tower Crane Operator 2012	0	0	0	0	0
Welder 2014	0	0	0	0	1
TOTALS	**41**	**0**	**2**	**2**	**47**

Notes: Year refers to the year the Red Seal Standard was last revised
Note: the dates shown are the most recent Red Seal available on its web site, on May 11,2021 the day the survey was completed

References to Climate Change Terms in Red Seal Templates for Construction Trades (4)

Occupation	Green Construction	Energy saving	Sustainability	Eco-friendly	Net Zero
Boilermaker RSOS 2016	0	0	0	0	0
Boilermaker Curriculum 2016	0	0	0	0	0
Bricklayer 2016	0	0	0	0	0
Cabinetmaker 2012	green market 1 grean cleaners 2	0	0	1	0
Carpenter 2013	green building 1	0	0	0	0
Concrete Finisher (RSOS) 2017	green concrete 2	0	0	0	0
Construction Craft Worker (NOA) 2015	green construction, green roofs ,green practices 4	0	0	0	0
Construction Electrician (RSOS) 2015	0	1	0	0	0
Construction Electrician (Curriculum) 2015	0	1	0	0	0
Drywall Finisher and Plasterer 2013	0	0	0	0	0
Gasfitter--Class A 2014	green building 1	cut energy use 1	0	0	0
Gasfitter--Class B 2014	green building 3	0	0	0	0
Glazier 2012	0	1	0	0	0
Heavy Equipment Operator (Dozer) 2015	0	0	0	1	0
Heavy Equipment Operator (Excavator) 2015	0	0	0	1	0
Heavy Equipment Operator (Tractor-Loader-Backhoe) 2015	0	0	0	1	0
Industrial Electrician (RSOS) RSOS 2016	0	2	0	0	0
Industrial Electrician (Curriculum) 2016	0	1	0	0	0
Insulator (Heating and Frost) -2018	0	2	0	1	0
Ironworker (Generalist) 2015	0	0	0	0	0
Ironworker (Reinforcing) 2015	0	0	0	0	0
Ironworker (Structural/Ornamental) 2015	0	0	0	0	0
Metal Fabricator (Fitter) 2012	0	0	0	0	0
Mobile Crane Operator 2013	0	0	0	0	0
Oil Heat System Technician 2015	0	energy /fuel savings 2	0	0	0
Painter and Decorator 2011	0	0	0	0	0
Plumber (RSOS) 2016	green initiatives 1	0	0	0	0
Plumber (Curriculum) 2016	green initiatives 1	0	0	0	0
Powerline Technician 2013	0	0	0	0	0
Roofer 2012	green roof alternatives, sustainable 12	0	6	0	0
Sheet Metal Worker 2018	green roof 2	Cut energy use 1	0	0	1
Sprinkler System Installer [NOT FOUND]					
Steamfitter/Pipefitter (RSOS) 2015	0	0	0	0	0
Steamfitter/Pipefitter (Curriculum) 2015	0	0	0	0	0
Tile Setter 2010	0	0	0	0	0
Tower Crane Operator 2012	0	0	0	0	0
Welder 2014	0	0	0	0	0
TOTALS	**0**	**8**	**6**	**5**	**1**

Note: Year refers to the year the Red Seal Standard was last revised

Note: the dates shown are the most recent Red Seal posted on its web site, on May 11,2021 the day the survey was completed

As noted, the previous survey only captures a portion of what apprentices are actually learning on the job and it is not intended to convey the impression that climate issues are absent from what they are learning both in the classroom and in the on-the-job portion of their training. But it does indicate that there is room to examine the Red Seal Standards to see where and to what extent information about climate science could be incorporated into the actual curricula being used for apprenticeship training. If we are to meet Canada's climate change targets, all avenues for promoting this objective need to be explored. What we expect apprentices to know as part of their training should be one part of this effort.

John Calvert May 12, 2021

Appendix 8

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