The purpose of this executive summary is to present an overview of the information gathered for the Sustainability Scholar project: Review of Energy Compliance Process for the University of British Columbia (UBC) Multi-family Buildings. This project was undertaken for UBC Campus and Community Planning (Sustainability and Engineering). The goal of this project is to improve implementation of energy requirements of the British Columbia Building Code (BCBC) and investigate the relationship of code requirements with the energy credits associated with UBC Residential Environmental Assessment Program (REAP 3.0) certification[1], for UBC multi-family buildings.

In the BCBC there are two main pathways to follow to achieve compliance for multi-family homes. The first is the National Energy Code of Buildings (NECB) 2011 and the second is American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE) 90.1 2010. Within the NECB 2011, there are multiple sections with multiple ways to achieve compliance. These sections include building envelope, lighting, heating ventilation and air conditioning (HVAC), service water heating (SWH), and electrical power systems and motors. Within each of these sections there is a choice of prescriptive compliance, trade-off compliance, and performance path compliance. Prescriptive requirements are set standards with which the building must comply. Trade-off compliance allows buildings to have requirements that are lower than standard by having other requirements exceed the standard within the same section, acting as a trade-off. Lastly performance path compliance is an energy modeling approach. In this path the builder must demonstrate that the proposed building is below or at the same the energy consumption of a building built to the prescriptive requirements.

The ASHRAE 90.12010 pathway also has multiple compliance paths embedded within it. Building envelope, HVAC, SWH, power, lighting, and other equipment are the sections in ASHRAE 90.1 2010. Within each of these sections there are mandatory requirements. Some sections also have the choice of prescriptive, trade-off, or energy cost budget (ECB) compliance pathways. ECB is also an energy modeling approach similar to NECB 2011's performance path method. The following table summarizes the high level differences between NECB 2011 and ASHRAE 90.1 2010.

	NECB 2011	ASHRAE 90.1 2010
Envelope	More Stringent	--
HVAC & DHW*	Slightly More Stringent	--
Lighting & Electrical	Same	Same
Trade off Options	For Every Section	For Some Sections
Energy Modeling	Based on "Energy Use"	Based on "Energy Cost"
Mandatory Provisions	None for Energy Models	Always Applied
Glazing Ratio Calculation	Only Above Grade	Includes Below Grade, Provision for Orientation
Climate Zone	Base on Authority having Jurisdiction; Refers to NBC HDD data	List of Climate Zones included in Standard

Notes:
*DHW = direct hot water

[1] https://sustain.ubc.ca/campus-initiatives/green-buildings/reap

REAP 3.0 is a green building rating system developed by UBC that is employed for residential developments on campus[2]. The rating system is organized similar to the Leadership in Energy and Environmental Design (LEED) rating system. REAP 3.0 is divided into the seven following categories: Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), Indoor Environmental Quality (IEQ), Construction (CON), and Innovation and Design Process (ID). Each of these categories have mandatory credits and optional credits. The amount of points received from the credits in each section determines the REAP rating which ranges from Gold (45 – 60 points) to Platinum Plus (101 – 134 points). Building envelope requirements for NECB 2011 and ASHRAE 90.1 2010 were compared to REAP 3.0. The table below provides a summary of the findings.

	Roof Insulation	Wall Insulation	Floor Insulation	Window Glazing
REAP 3.0	R-40 *Buildings with attic space* R-28 *Cathedral ceilings/flat roofs*	R-15.6 *Effective overall aboveground non-glazed* R-7.5 ci B*elow grade walls*	R-30 *Framed floors* R-15.6 *Slab floors*	U-0.35 *Overall value for non-metal framed* U-0.45 *Overall value for metal framed*
NECB 2011	R-25 *AGOBA* R-10 *ACG*	R-18 *AGOBA* R-10 *ACG*	R-7.5 *ACG floor*	U-0.423 *For all fenestration*
ASHRAE 90.1 2010	R-20 ci *Insulation entirely above deck* R-13.0 + R-13.0 *Metal building* R-38 *Attic and other*	R-13.0+R7.5 ci *Steel framed* R-13.0+R7.5 ci *Wood framed and other* R-7.5 *Walls below grade*	R-30 *Steel joist* R-30 *Wood-framed and other* R-10 *Slab on floor, unheated* R-15 *Slab on floor, heated*	U-0.35 *Non-metal framing* U-0.45 *Metal framing (Curtainwall/storefront)* U-0.80 *Metal framing (Entrance door)* U-0.55 *Metal framing (All other)*

Notes:
R Value units are btu/(h°F ft^2)
U Value units are h°F ft^2/btu
AGOBA = above ground opaque building assembly ACG= assembly in contact with ground
ci=continuous insulation

The current and underway REAP 3.0 buildings on UBC were also considered and their values were compared to the BCBC requirements and REAP 3.0 requirements. The REAP 3.0 requirements generally led to the buildings having more stringent values than the code requirements. Future studies will be performed on this topic to help develop the REAP building certification at UBC and to aid in developing code requirements as well to reduce energy consumption.

[2] https://sustain.ubc.ca/campus-initiatives/green-buildings/reap