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1. INTRODUCTION

This Tenant Green Design Guide for Commercial Interiors is supplemental to, and is intended to be read and used in conjunction with, the buildings' Tenant Design Criteria Manual . This guide provides general information regarding the greening of building office space.

The Lease and any other agreement(s) between the tenant and landlord of the building shall govern and take precedence over any information included in the Tenant Design Criteria Manual and this Tenant Green Design Guide.

This guide uses the term green design to indicate environmentally friendly preferences in design and tenant improvement decisions.

Bentall Kennedy is one of Canada's leading proponents of green office space, and as such, this guide has a number of measures that all tenant improvements are required to follow. Additionally, a list of recommended, or stretch, targets has also been provided. The required and recommended targets are identified by the following icons:



A summary of all the required and recommended targets is included in Section 9.

How to Use this Guide

Asset managers, property managers, engineers, leasing agents, construction managers, and members of design/construction teams should use this manual as a tool to initiate discussion and facilitate the implementation of sustainable tenant improvements (TIs).

When bidding out TI projects, this manual should be provided to contractors, architects/designers, and other responsible parties. It may be appropriate to include some of the requirements and recommendations in various project documents such as the construction contract, specifications and scope of work letter.

Bentall Kennedy does not recommend or require any specific products or manufacturers as long as the sustainability requirements are met. However, Bentall Kennedy suggests using proven companies that provide market-leading services and products. Where possible, sample products that meet the given sustainability criteria are identified in this guide. The project team (i.e., property manager, construction manager, architect etc.), in consultation with the asset manager, should select the most appropriate sustainable option for the building's office space, given financial, environmental, and social considerations. Property managers may have a list of vendors that have already been successfully used at the building, or at other buildings within their market.

2. WHY A GREEN DESIGN?

It is well documented that more than 30% of the global energy produced and 60% of the electricity generated is consumed by buildings annually. A typical North American commercial construction project generates up to 1.13 kilograms or 2.5 pounds of solid waste per square foot of occupied floor space.

A green design not only has a positive impact on public health and the environment, it reduces operating costs, enhances employer organizational marketability, has the potential to increase occupant productivity and demonstrates a commitment to a sustainable community. Beyond that, it contributes to a sustainable environment by reducing our energy and natural resource consumption and cutting down on the waste and pollution we create.

Many leading organizations consider the impact their workplaces have on a range of financial drivers. A green design can assist in securing a competitive advantage in the following areas:

- Enhance company reputation
- Attract and retain the best employees
- Enhance employee wellbeing and productivity
- Enhance and protect organizational knowledge
- Reduce Liability

Some of the economic benefits of a green building are:

- Fewer employee sick days taken and heightened worker productivity due to improved indoor environment
 - Research¹ on the effects of improved indoor air quality has shown it can lead to an average productivity increase of 2% (roughly \$5/ft²), and on average one less sick day per employee annually (roughly \$1.5/ft²)
- Lower utility bills and operating costs because of energy and water efficiency systems
- Lower waste and dumping costs because of landfill diversion measures (recycling/reuse programs) used during construction and occupancy
- Lower energy bills from efficiencies in HVAC systems

¹ Miller, N.G., Pogue, D., Gough, Q.D., and S. Davis, 2009. Green Buildings and Productivity. Journal of Sustainable Real Estate, Vol. 1, No. 1. <http://www.costar.com/josre/JournalPdfs/04-Green-Buildings-Productivity.pdf>

3. GETTING STARTED

Whether you have an in-house team that serves your facility design needs or you rely on outside firms to assist you, it is paramount that you select design consultants that are wholly committed to a green design. Once your design team is established choose other advisors (including engineers, suppliers, commissioning services and contractors) that are equally engaged in environmental best practices.

Key considerations in a green design include:

- Energy efficiency in mechanical and electrical installations that address thermal considerations, noise and indoor air quality requirements and flexibility and privacy needs
- Environmentally friendly interiors that support healthy work environments and avoid / minimize harmful emissions
- Effective Waste Management practices and indoor environmental controls during renovation work

This document includes a number of initiatives and strategies that should be considered when arranging service agreements and construction documents and will assist you in developing and refining plans and specifications that achieve your green design goals.

Often the first question asked is “What is the cost of a green design?” Many measures can be implemented with no additional cost while others may involve minimal upfront costs but will save money over the long haul. Some green measures may cost considerably more, but yield benefits that are more difficult to quantify, such as improved productivity. In all cases, the key to eliminating or minimizing additional costs is to establish your design team and set your goals very early in the process.

4. WATER EFFICIENCY

REQUIRED	Low flow water fixtures
RECOMMENDED	Lower flow water fixtures

It is important to consider reducing our consumption of this resource in order to ease the burden on water and sewer infrastructure systems in our cities. Through green design you can maximize water efficiency within your space to reduce the burden on water supply and waste water systems.

Installation of low flow water fixtures is required to reduce potable water consumption by at least 20% over a typical new installation. Use the flow rates provided in the table below as a guide to achieve this goal. For project teams that wish to further minimize their water consumption, stretch goals are also provided.



Fixture Type	Maximum Flows (Required)				Stretch Goals (Recommended)			
	Metric		Imperial		Metric		Imperial	
Water Closets	4.8	LPF	1.28	GPF	3/6 dual fl	LPF	0.8/1.6 dual fl	GPF
Urinals	1.9	LPF	0.5	GPF	Below 1.9 LPF down to and including waterless			
Shower Heads	7.6	LPM	2.0	GPM	5.7	LPM	1.5	GPM
Washroom Faucets	1.9	LPM	0.5	GPM	Lower flow may impact performance			
Kitchen Faucets (replacement aerators)	7.6	LPM	2.0	GPM	5.7	LPM	1.5	GPM
Metering Faucets	0.95	L/CY	0.25	G/CY	Lower flow may impact performance			

Index:

(LPF) liters per flush (LPM) liters per minute (L/CY) liters per cycle
 (GPF) gallons per flush (GPM) gallons per minute (G/CY) gallons per cycle

Choose the most efficient water consuming fixtures available when installing new fixtures, whether these are for a kitchen, private bathroom, employee gym, etc. Technologies are changing at a rapid pace so ensure your consultants incorporate the best available in your green design.

5. ENERGY EFFICIENCY

REQUIRED	Lighting	New lighting must be no more than 10.06 W/m ² (0.935 W/ft ²) One lighting control strategy using occupancy or daylight sensors
	Energy	HVAC and lighting to comply with ASHRAE Standard 90.1-2007
	Refrigerants	No new CFCs; existing CFCs must have phase-out plan
	Equipment	Install only Energy Star rated equipment and appliances
RECOMMENDED	Lighting	Provide lighting controls (desk lamps) to 90% of occupants New lighting to be more efficient than the above requirement
	Refrigerants	No new equipment to use HCFCs
	Measurement	Install metering to measure and record utility consumption
	Commissioning	Engage a commissioning authority
	Green Power	Offset 50% of annual electricity with offsite green power purchase

5.1 Lighting

Understandably, a lot of emphasis goes into designing premises lighting in a green design. After all, it accounts for more than 60% of total premises energy costs and represents the largest single opportunity for savings. The building's standard lighting system already achieves a high level of energy performance though the use of T8 lighting.

Any changes to the lighting system should be designed to reduce the lighting power by 15% below that allowed by ASHRAE 90.1-2007. That standard has an allowance of 11.84 W/m² (1.1 W/ft²) for office space, therefore a 15% reduction equates to 10.06 W/m² (0.935 W/ft²).



To minimize lighting energy use, four main strategies should be used:

1. Maximize natural light,
2. Provide directed task light where required,
3. Install efficient fixtures and lamps and
4. Use advanced lighting controls.

An added benefit to lowering the energy use in lighting systems is the reduction in localized heat loads which enhances occupant comfort and minimizes the amount of cooling energy required.

Natural Light

Taking advantage of as much natural light as possible, and minimizing the use of electric lights, should be the initial focus. This can be accomplished through use of open floor plan offices, low height partitions and furniture, and locating private offices and meeting rooms away from the perimeter and towards the core of the building. Additionally, specifying the use of lighter coloured paints and surfaces increases the rebounding of light rays and reduces the amount of electric light required to obtain a certain ambient lighting level.

Task Lighting

Building occupants have different lighting needs at different times. Providing the appropriate level of lighting for different tasks reduces energy use, compared to centrally-controlled overhead lighting, which lights the entire tenant space for the task requiring the highest lighting level. Individual lighting controls also increase occupant satisfaction and comfort with light levels.

Consider providing individual lighting controls for at least 90% of occupants to enable adjustments to suit individual task needs and preferences. This can be achieved cost-effectively through task lighting (ie: desk lamps) at individual workstations and offices, or controllable lights built into system furniture, allowing the amount of overhead lighting provided to be reduced.



RECOMMENDED

In addition, consider providing separate lighting system controls for all shared multi-occupant spaces (e.g., meeting rooms, conference rooms) to enable adjustments to suite the various uses of the room.

Fixtures and Lamps

Energy efficient solutions are flooding the marketplace at an increasing rate and your design team is crucial to ensuring the latest technologies are used.

A green design for lighting incorporates many elements, the highlights of which are detailed below:

- Use energy efficient fluorescent lights with electronic ballast (less than 10W/m² or 0.93 W/ft²) for general office lighting
- Use 25W or 28W T8 fluorescent tubes, or LEDs.
- For special purpose lighting, use compact fluorescents (CFLs) or LED's, instead of halogen or MR-16s.
- Use fixtures and lamps which carry the Energy Star logo.

Lighting Controls

Lighting controls are a cost-effective energy efficiency solution. Because the need for lighting varies with occupancy and daylight levels, lighting controls save energy by turning off or dimming lights when they are not needed. They also enhance occupant comfort by not over-lighting spaces.

Daylight-responsive controls (also known as photosensors or photocells) sense the amount of daylight present and turn off or dim lights when they are not needed.

Occupancy or motion sensors detect movement in a space and respond by either keeping the lights on (when movement is detected) or turning off or dimming lights (when the space is unoccupied).

Combination daylight/occupancy sensors are also available.

Incorporate at least one of the following three control strategies:

- Install daylight-responsive controls in regularly occupied spaces that are within 4.6 m (15 ft) of windows and under skylights.
- Install daylight responsive controls for 50% of the lighting load.
- Install occupancy sensors for 75% of the lighting load.



Ensure that occupancy sensor “time to off” is set as low as possible – e.g. 5 minutes, rather than the pre-set 30-45 minutes.

Through effective use of the above three elements, additional savings above the minimum 15% reduction can be achieved. Aim for stretch goals (recommended targets) of:

- 8.88 W/m² (0.825 W/ft²); 25% below standard
- 7.70 W/m² (0.715 W/ft²); 35% below standard



RECOMMENDED

5.2 Equipment and Appliances

Install only Energy Star rated equipment and appliances. Relevant equipment includes:

- Office equipment: computers, monitors, printers, scanners, copiers, fax machines, digital duplicators, servers, external power adapters, mailing machines, and water coolers
- Appliances: refrigerators, freezers, and dishwashers
- Electronics: TVs, DVD players, projectors, and combination units
- Commercial food service equipment



Equipment that is being reused from another location is exempt from this requirement. Also excluded from this requirement are HVAC, lighting, and building envelope products, which all should be encompassed in the overall energy efficiency strategy for the TI.

Almost all leading brands carry ENERGY STAR qualified products. Product listings can be found at www.energystar.gov/products.

Ensure equipment and computers are turned off when not in use.

5.3 Minimum Energy Performance

Design the tenant improvement project to comply with ASHRAE Standard 90.1-2007, where applicable (including lighting and HVAC system). This includes the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4), and either the prescriptive requirements (Sections 5.5, 6.5, 7.5 and 9.5) or performance requirements (Section 11) of the ASHRAE standard. The standard covers measures related to minimum efficiency of and controls for HVAC, lighting, and water heating equipment. More information can be obtained at www.ashrae.org.



5.4 Heating Ventilation and Air Conditioning:

A successful green design for HVAC is often conditional on the base building capacities and systems. Where feasible:

- Provide for separate control zones in every room or area with a solar exposure
- Zone interior spaces separately
- Install controls and systems capable of sensing space use and modulating HVAC systems in response to space demand. This includes private offices and specialty occupancies (conference rooms, kitchens, etc.)

5.5 Refrigerants

The federal government is phasing out ozone-depleting chlorofluorocarbons (CFCs) in HVAC systems. Implement any of the following strategies that apply to your Tenant Improvement project:

- When installing new systems and products or replacing existing systems as part of the tenant's scope of work, the new systems must not contain CFCs.
- When reusing existing HVAC systems in the tenant's scope of work, inventory equipment and identify any that use CFC-based refrigerants, with the goal of phasing out the CFC-based refrigerant in the future.
- Consider also excluding hydrochlorofluorocarbons (HCFCs) from new installed systems. HCFCs are a less hazardous choice than CFCs but also have environmental impacts.



Small HVAC units, standard refrigerators, small water coolers and any other cooling equipment that contains less than 0.22 kg (0.5 lbs) of refrigerant are exempt.

RECOMMENDED

5.6 Construction and Commissioning

The construction phase begins once you have a contract with the contractor you have selected. It ends when the project is complete and ready for occupancy. The last step prior to occupancy should be a commissioning period.

A project cannot be deemed a success until proven with written verification that confirms the project's mechanical, HVAC and electrical systems are installed and calibrated and performance is validated to the intended design. This verification process is completed by a commissioning team and should be included as part of your project work.

Consider engaging a designated commissioning authority and include commissioning requirements for HVAC, lighting systems and controls, hot water, and renewable energy (if applicable) in contract documents. At a minimum, the engineer and/or contractor should perform basic testing and balancing if any changes are made to HVAC systems during the TI, and should perform a review and sign-off on any affected building systems prior to occupancy.



For added value, consider performing fundamental or enhanced commissioning, as appropriate for complex systems.

5.7 Green Power

Bentall Kennedy encourages tenants to purchase green power that has met Green-e certification requirements. Renewable Choice Energy offers a bulk discount for Bentall Kennedy tenants.



Green power is produced off-site from renewable energy sources such as solar, wind, geothermal, biomass, or low impact hydropower, and delivered to the grid. Purchasing green power helps to reduce the negative impacts of fossil fuel use and supports the creation of a robust infrastructure for clean, renewable energy.

Green power purchase costs vary by market and type; see the Information and Resources section for additional information.

A general suggested guideline is to purchase 50% of the annual electricity used by your office, for two years, from a green power source (i.e. annual electricity use x 50% x 2 years).

5.8 Energy Measurement

The ability to track energy consumption within the premises is a key step in energy conservation and awareness. It allows ongoing accountability and optimization in energy performance over time.

Consider installing metering equipment that measures and records consumption within your space on all electrical, gas and water services. Energy usage monitoring will allow you to identify, influence and see the results of any energy programs and initiatives you undertake. Many companies are actively engaging their employees to reduce their carbon footprint (energy use and travel). Likewise, Bentall Kennedy has tenant engagement programs available to encourage and promote occupants to help reduce the building's energy and waste consumption.



RECOMMENDED

For tenants that occupy a significant portion (e.g., more than 75%) of the total building, installing continuous metering is recommended to isolate and analyze energy performance of the following systems:



RECOMMENDED

- Lighting systems and controls
- Constant and variable motor loads
- Variable frequency drive (VFD) operation
- Chiller efficiency at variable loads (kW/ton)
- Cooling load
- Air and water economizer and heat recovery cycles
- Air distribution static pressures and ventilation air volumes
- Boiler efficiencies
- Building-related process energy systems and equipment
- Indoor water riser and outdoor irrigation systems

Engage a qualified contractor to assist with the metering system design and installation.

6. HEALTHY AND ENVIRONMENTALLY FRIENDLY INTERIORS

REQUIRED	New Materials	Recycled content (post + ½ pre) is at least 10%
		CRI Green Label+ Carpet and FloorScore hard flooring
	Recycling	Recycling and organics bins wherever waste bins are provided
	Paints	Use low VOC paints, sealants, coatings, and adhesives
	Composites	Composite wood must not contain added urea-formaldehyde
	Indoor Air	Air quantities as per Sections 4 through 7 of ASHRAE 62.1-2007
	Comfort	HVAC designed to meet ASHRAE 55-2004
RECOMMENDED	New Materials	Recycled content (post + ½ pre) is at least 20%
		10% extracted and 20% manufactured regionally
		50% of wood based materials to be from FSC wood
		5% of materials to be rapidly renewable
	Layout	Locate open work spaces and offices around perimeter
	Furniture	Specify Greenguard Certified furniture
	Comfort	Provide thermal controls to 50% of occupants
	Pollutants	Specialty ventilation, entrance mats, high efficiency filters
Cycling	Secure bike storage for 5% of employees, showers for 0.5%	

6.1 Minimum Indoor Air Quality

A major component of overall indoor environmental quality, Indoor Air Quality (IAQ) is especially important to occupant health.

Require that the mechanical engineer design the ventilation systems to meet the minimum requirements of Sections 4 through 7 of ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality. They should modify or maintain the existing building outside-air ventilation distribution system to supply at least the outdoor air ventilation rate required by ASHRAE. If that is not possible, they should document the applicable space and system constraints, and achieve the maximum possible airflow with a minimum of 4.72 L/s (10 ft³) per person.



6.2 Thermal Comfort

Comfortable building occupants are healthier and more productive. A well-designed HVAC system is able to meet comfort criteria (air temperature, radiant temperature, air speed, and relative humidity) under normal operating conditions.

Evaluate these criteria together and coordinate system design with the requirements of “Minimum Indoor Air Quality” in order to meet ASHRAE Standard 55-2004, and demonstrate design compliance in accordance with documentation outlined in Section 6.1.1 of that standard.



Building occupants have a wide range of preferred thermal comfort zones. By allowing individuals to adjust their thermal conditions (including temperature and ventilation), tenants can provide improved comfort and satisfaction for their employees.

Providing these controls is straight forward in some buildings, but very difficult in others, depending on the office layout and HVAC system. Some common types of individual controls include diffusers in underfloor HVAC systems, and operable windows. If these systems are present in your office, consider providing controls to 50% of occupants, and provide controls for shared and multi-occupant spaces (such as conference rooms).



This suggestion should be balanced with the energy efficiency goals of the building, since allowing individuals to control temperatures and ventilation has the potential to impact HVAC operations and the associated energy usage. Integrating occupancy sensors into the thermal comfort controls – so that the systems can automatically be set back when the space is unoccupied – can help avoid a potential energy consumption increase.

6.3 Sourcing of New Materials

The most environmentally friendly material is the one that you do not need to purchase. Review both your previous office space as well as the new location for any materials, furniture, and finishes that can be reused. See the Waste Management section of this guide for information and suggested targets for material reuse.

When new materials and products are required, there are a number of environmentally friendly properties which you can request or specify them to contain. The use of these materials can greatly reduce the environmental impact of your project. These properties are briefly described below.

Recycled Content

Recycled content may include post-consumer and/or pre-consumer materials:

- Post-consumer material: generated by households or facilities in their role as end-users of the product, which can no longer be used for its intended purpose (such as plastic bottles or aluminum cans).
- Pre-consumer material: diverted from the waste stream during the manufacturing process. An example of this is sawdust from a lumber mill that a manufacturer purchases to use in its composite wood products.

Select materials, including furniture and furnishings², with recycled content such that: (post-consumer recycled content) + 1/2 (pre-consumer recycled content) is at least 10% of total value of all materials used for the project.



The recycled content value of a material or product is determined by weight. The recycled fraction of the product is then multiplied by the cost to determine the recycled content value. Mechanical, electrical and plumbing components cannot be included in this calculation.

As a stretch goal, consider requiring at least 20% of total value of materials used to be from recycled content.



²Furnishings consist of miscellaneous items such as casework, countertops, window treatments, entrance mats/rugs, planters, and waste receptacles; whereas furniture refers to standard items such as seating, work stations, and tables.

Regional Materials

Consider specifying regional manufactured and extracted materials. These properties help to reduce the project's environmental impacts by reducing the transportation required to deliver the products to your project, while supporting the regional economy. Consider recommended targets of specifying a minimum of:

- 10% (by cost) of the combined value of construction materials and furniture to be extracted within 800 km of the project site, and
- 20% to be manufactured within 800 km of the project site.



RECOMMENDED

Certified Wood

Choosing FSC-certified wood ensures that wood products do not come from protected natural forests or habitats and were not treated with highly hazardous pesticides. Consider specifying a minimum of 50% (by cost) of wood based construction materials and furniture/furnishings to be from FSC-certified wood.



RECOMMENDED

Rapidly Renewable Materials

Use building products made from rapidly renewable materials (those harvested on a 10-year or shorter cycle). These may be available for little to no cost premium and can include:

- Wool carpet in place of carpet made from synthetic materials
- Bamboo or cork flooring in place of hardwood
- Linoleum flooring in place of vinyl
- Cotton batt insulation in place of fiberglass
- Wheatboard, strawboard, or sunflower seed board in place of typical composite wood

A suggested stretch goal is for the value of rapidly renewable materials to equal at least 5% of the total materials cost. This includes construction materials, furniture and furnishings, and other products.



RECOMMENDED

6.4 Floor Materials

Floor finishes have the greatest single environmental impact of any fixed item over the life of a typical tenant's occupancy timeframe. This is due to a tendency to replace floor materials at the end of every lease cycle. If reusing existing floor finishes is not possible or practical, many environmentally friendly options are available at similar and often lower cost than typical selections. Some examples:

- Use modular carpets, reconditioned options or those with high recycled content
- Choose low emissions products
- Use linoleum (a rapidly renewable materials) instead of vinyl
- Select carpets from vendors who will take back the product for recycling at the end of its useful life.

The following requirements must be met when specifying new flooring materials:

- All carpet must meet the requirements of the Carpet and Rug Institute (CRI) Green Label Plus, and carpet cushion must meet the requirements of the CRI Green Label program.
- All carpet adhesive must have less than 50 g/L VOC content. Other flooring adhesives and finishes must meet the requirements of Low-Emitting Adhesives/Sealants and Paints/Coatings detailed below.
- All hard flooring must be certified as compliant with FloorScore standards. This includes vinyl, linoleum, laminate, wood, ceramic, rubber, and wall base.



6.5 Coatings, Sealants, Paints, and Adhesives

Minimize the amount of volatile organic compounds (VOC) in coatings, sealants, paints, and adhesives that are specified. This contributes to a healthier and more pleasant work environment for staff, especially at the beginning of your occupancy. Avoid the use of vinyl wall coverings as much as possible as most tend to have a high VOC content.

To promote good IAQ, use building materials and products with VOC content no greater than those shown in the table below³. The VOC contents of a product can be readily obtained from its Material Safety Data Sheet (MSDS), provided by the manufacturer. Low VOC products are typically available at no cost premium.



Architectural Applications	VOC Limit [g/L less water]	Specialty Applications	VOC Limit [g/L less water]
Indoor Carpet Adhesives	50	PVC Welding	510
Carpet Pad Adhesives	50	CPVC Welding	490
Wood Flooring Adhesives	100	ABS Welding	325
Rubber Floor Adhesives	60	Plastic Cement Welding	250
Subfloor Adhesives	50	Adhesive Primer for Plastic	550
Ceramic Tile Adhesives	65	Contact Adhesive	80
VCT & Asphalt Adhesives	50	Special Purpose Contact Adhesive	250
Drywall & Panel Adhesives	50	Structural Wood Member Adhesive	140
Cove Base Adhesives	50	Sheet Applied Rubber Lining Operations	850
Multipurpose Construction Adhesives	70	Top & Trim Adhesive	250
Structural Glazing Adhesives	100		
Substrate Specific Applications	VOC Limit [g/L less water]	Sealants	VOC Limit [g/L less water]
Metal to Metal	30	Architectural	250
Plastic Foams	50	Nonmembrane Roof	300
Porous Material (except wood)	50	Roadway	250
Wood	30	Single-Ply Roof Membrane	450
Fiberglass	80		420
Sealant Primers	VOC Limit [g/L less water]	Aerosol Adhesives	VOC Weight [g/L minus water]
Architectural Non Porous	250	General purpose mist spray	65% VOCs by weight
Architectural Porous	775	General purpose web spray	55% VOCs by weight
Other	750	Special purpose aerosol adhesives (all types)	70% VOCs by weight

³ The source for the VOC limits for non-aerosol adhesives is the South Coast Air Quality Management District (SCAQMD) Rule 1168. For aerosol adhesives, the source is the Green Seal Standard for Commercial Adhesives, GS-36. For paints, source is Green Seal Standard GS-11 (and GS-03 for Anti-corrosive paints). For Finishes, sealers, shellacs, and stains, source is SCAQMD Rule 113.

Paints	VOC Limit (g/L)	Clear Wood Finishes	VOC Limit (g/L)
Flat	50	Varnish	350
Non-Flat	150	Lacquer	550
Anti-corrosive / anti-rust	250		
Sealers	VOC Limit (g/L)	Shellacs	VOC Limit (g/L)
Waterproofing sealers	250	Clear	730
Sanding sealers	275	Pigmented	550
All other sealers	200		
Stains	VOC Limit (g/L)		
All stains	250		

6.6 Furniture and Composite Wood

General office furniture contributes to a significant percentage of waste going to landfills. Consider reusing as much office furniture as possible which saves money and the environment (see the Waste Management section of this guide for more details). Cost effective, green, and healthy (no or low VOCs) products are readily available and some manufacturers agree to take back products for reuse or recycling at the end of your use.

Wherever composite wood and agriculture fiberboards are specified (including in casework, millwork, and finished panels), ensure they contain no added urea-formaldehyde resins, which is a known carcinogen.

Workstations can also have a significant environmental impact, particularly if they are not designed for easy assembly and reassembly, and capable for reuse or recycling. Improvements to indoor environment quality can be attained through the use of products that contain no or low VOCs. Consider specifying furniture which is Greenguard Indoor Air Quality Certified, which ensures it meets strict requirements relating to product off-gassing of harmful chemicals.



6.7 Office Layout / Daylighting and Views

Research indicates a link between open plan work environments and improved organizational learning and productivity. By reducing the amount of walls or offices and moving towards an “open work” plan, you can reduce up front costs while increasing employee morale and wellbeing.

Consider locating open work spaces and offices around the perimeter of the tenant space, providing the majority of employees with access to windows, and locating non-regularly-occupied areas (such as conference rooms, employee kitchens, and break rooms) in the interior of the floor plate. Other strategies to consider include:

- lower partition heights,
- interior glazing, and
- high ceiling reflectance values.



Provide shading and/or glare control devices such as operable blinds to ensure daylight effectiveness and control glare.

6.8 Recycling & Organics Bins:

Provide recycling and organics bins wherever waste is most likely to be generated and wherever waste bins are provided. The following waste streams should be collected separately, unless the building's waste management firm allows for comingled waste which is sorted off-site. Coordinate with property management to determine what level of sorting they require.



Kitchens/Kitchenettes/Serveries	Photocopy Areas	Meeting/Boardrooms
- Organics	- Paper	- Paper
- Cans and Bottles	- Toner Cartridges	- Cans and Bottles
- Paper	- Battery Recycling	
-Plastics and Styrofoam		
- Waste		

Each receptacle should be properly labeled according to the building's identified waste streams. Conduct ongoing employee education (e.g. signage, information sessions, waste audits) on proper waste separation and recycling.

6.9 Minimize Pollutant Sources

It is important to minimize the pollutants that enter the building, and to appropriately manage those that are created within. Consider implementing the following control measures:



RECOMMENDED

- If the tenant space has entrances leading to the exterior, install walk-off grilles or grates to prevent dirt and particulates from entering the building.
- Where hazardous gases or chemicals may be present or used (including janitorial, copying, and printing rooms), provide segregated areas with self-closing doors and deck-to-deck partitions. Also provide separate outside exhausting at a rate of at least 9.2 m³ / hour per m² (0.5 ft³ / minute per ft²), with no air recirculation, maintaining a negative pressure compared with the surrounding spaces. (This consideration may add costs to the project.)
- Consider providing regularly occupied areas of the tenant space with new MERV 13 or better air filtration media prior to occupancy.

6.10 Bicycle Storage & Change Rooms

To encourage employees to run or cycle, consider incorporating secure bike storage and showers/ changing rooms into your space. Many racks and hanger systems are available for efficient bicycle storage. In shower rooms, consider supplying lockers as well.



RECOMMENDED

A suggested guideline is to provide secure bicycle storage for 5% of employees, and to provide showers for 0.5% of employees.

7. DURING CONSTRUCTION OR RENOVATIONS

REQUIRED	Waste	Divert at least 50% of waste from disposal in landfills
	IAQ	Implement an IAQ construction plan
RECOMMENDED	Waste	Divert at least 75% of waste from disposal in landfills
	Reuse	Reuse 40-60% of floors, walls, ceilings
		Reuse 5-10% of materials (not including furniture)
		Reuse 30% of furniture
IAQ	Develop IAQ pre-occupancy plan (flush-out or testing)	

7.1 Waste Management

Divert at least 50% of demolition and construction waste from disposal in landfills.

Your contractor should be advised to contact local salvaging/recycling companies and arrange for recycling services. At a minimum, you should ensure your contractor recycles the following waste materials that could not be reused and may be generated throughout demolition and construction:

- Concrete / masonry / stone	- Plastic
- Steel and other metals	- Blue Box Waste
- Wood	- Glass
- Gypsum	- Ceiling Tiles
- Cardboard	- Carpet

An important element of the commitment to waste management is ensuring effective documentation is kept during the construction process. This is done through a Waste Diversion Report. The report is comprised of a compilation of waybills, invoices, letters and other documentation from your suppliers/contractors that is appropriately indexed and shows quantities and details (such as material type, load ID number and date) of waste diverted from and sent to landfill. A copy of your Waste Diversion Report should be provided to Bentall Kennedy when completed.

It is therefore essential that you inform your contractor early in the renovation process about the following processes and procedures that form part of an effective construction waste management plan. Note that the following points are not required, but are recommended to help ensure that the 50% diversion requirement is met.

- Designate a central Waste Collection Area onsite that is dedicated to the separation and storage of all waste generated during demolition and construction.
- Provide separate containers in the Waste Collection Area that are sized to accommodate the estimate amount of each waste type and quantity.
- Clearly indicate the material type being stored in each container using appropriate signage and labels.
- If space is insufficient to provide proper sorting, ship all materials to a sorting station.
- Co-ordinate daily inspections of containers to check for and remedy cross contaminations.
- Ensure the material type is clearly labeled on each container.
- Arrange for and/or promptly transport containers to receiving facilities when containers are full.



- Obtain weighbills showing the quantity of each material type leaving site (both diverted and non-diverted).
- Describe where materials to be diverted from landfill will be sent, and what their final end-use will be.
- Provide “blue box” recycling bins on site for recycling waste generated by site workers and visitors.
- Have suppliers and contractors provide a letter listing the item(s) to be reused and the item(s) and quantity being removed from the site.
- Those items being removed from the site should show a list of proposed salvaging / recycling facilities to be used and further specify the material(s) that will be accepted by each facility and whether the material(s) will be reused, recycled or sent to landfill.
- Follow any salvaging / recycling facilities’ material acceptance requirements to ensure materials are properly sorted, grouped and packaged for collection.

If the above practices are undertaken, significantly more waste should be diverted than 50%. Consider asking your contractor to meet the stretch recommended goal of 75% diversion.



RECOMMENDED

7.2 Materials Reuse

If your renovation is due to a relocation, be sure to walk through your new premises and give careful consideration to any existing fixtures and furniture that can be reused. Also look to reuse whatever materials, equipment and resources you can from your existing premises.

Reasonable targets are to maintain 40% or even 60% by area of existing floors, walls, and ceilings. If materials are being taken from one site to another, or are being salvaged from a site which is being completely deconstructed, but will be reused in the rebuilt space, a reasonable target would be to reuse 5% or 10% of all materials by cost (not including furniture). Applicable salvaged materials include wall paneling, cabinetry, ceiling tiles, flooring, door hardware, and built-in furniture, but does not include movable partitions, furniture or other transient items. When furniture can be reused, a good target is to use 30% of the total furniture budget on reused items (based on their new, replacement value). If this is followed, you effectively save 30% of your furniture budget.



RECOMMENDED

7.3 Indoor Environment

Prevent indoor air quality problems arising from the construction / renovation process.

Ensure that the contractor develops and implements an IAQ construction plan that includes the following requirements:

- Follow the 2007 Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction (www.smacna.org).
- Protect all materials from moisture damage whether stored on-site or installed with the use of absorptive materials.
- Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 at each return air grill when air handlers are used during construction. Air handling systems serving the premises will only be turned on in the construction area when filters have been installed, and all filters will be replaced prior to occupancy.



REQUIRED

Many construction materials off-gas after installation. Post-construction cleaning of tenant spaces can also be harmful, especially if solvents are used. One way to mitigate these IAQ risks is to develop an IAQ Pre-Occupancy Plan and implement it after installation of all finishes, furniture and fixtures; after completion of building cleaning; and before occupancy. The plan should include one of the following two measures:



RECOMMENDED

- Install new filtration media and flush out the building by supplying 4,300 m³ of outdoor air per m² of floor area (14,000 ft³ of air per ft² of space), while maintaining a temperature of at least 16°C (60°F) and relative humidity no higher than 60%.
- Through air testing (conducted in accordance with testing protocols of the EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air), air contaminants should not exceed the specified amounts in the table below.

Contaminate	Maximum Concentration
Formaldehyde	27 parts per million
Particulates (PM10)	50 micrograms per cu. Meter
Total Volatile Organic Compounds (TVOC)	500 micrograms per cu. Meter
4-Phenylcyclohexene (4-PHC)	6.5 micrograms per cu. Meter
Carbon Monoxide	9 ppm and no greater than 2 ppm above outdoor levels

Additionally, reduce the quantity of indoor air contaminants that are odorous, potentially irritating and/or harmful to the comfort and well being of installers and occupants. This would include adhesives, sealants and sealant primers. Specify low volatile organic compound (VOC) materials in all products being used. This is often accomplished with no additional cost.

Special consideration should be given to the selection of furniture and fixtures to ensure VOC levels are minimized and sufficient time for “off gassing” of new furniture is allowed to occur in a warehouse designed for this purpose rather than on the construction site. Be sure to order these products early in your process so it does not delay your overall construction schedule.

8. INFORMATION AND RESOURCES

To assist you in your pursuit of a green office, we have identified a few of the thousands of web sites and resources available online.

General Resources:

- eBUILDSMART®: A program of Metro Vancouver, is a sustainable building information source for the design and construction industry, helping make smart, sustainable choices when crafting the future of our constructed environment. The site features a sustainable products directory, technical resources, and information covering the life cycle of a building including; Design, Construction, Operations, Retrofit/Renovation and finally Deconstruction. www.gvrd.bc.ca/BuildSmart/

Water Fixture Resources:

Look for the EPA WaterSense label on products, and visit the WaterSense Web site to find products and rebates: www.epa.gov/watersense/

- American Standard: <http://www.americanstandard-us.com/water-efficiency/>
- Delta: www.deltafaucet.ca
- Grohe: www.grohewatercare.com/bath.htm
- Kohler Triton Faucet; Kohler Steward Waterless Urinal: <http://www.savewateramerica.com/index.htm>
- Moen Envi Showerhead: <http://www.moen.com/eco-performance>
- NEOPERL: www.neoperl.com
- Niagara: www.niagaraconservation.com/Aerators.html and www.niagaraconservation.com/Showerheads.html
- Sloan: www.waterefficiency.com/products.html
- Toto: <http://www.totousa.com/Green/Totology.aspx>
- Zurn: <http://www.zurn.com/Pages/SustainabilityNew.aspx>

Lighting Fixture Resources:

Look for the ENERGY STAR label on bulbs and fixtures.

Search for efficient lighting solutions at www.energystar.gov/lighting

Lighting Controls Resources:

- Douglas Lighting Control: www.douglaslightingcontrol.com
- Hubbell Lighting: <http://www.hubbellighting.com/resources/greenwise/Control.php>
- Leviton: www.leviton.com/OA_HTML/ibeCCtpSctDspRte.jsp?section=15550&minisite=10025
- Lutron: <http://lutron.com/products>
- Sensor Switch: www.sensorswitch.com/OnlineCatalog.aspx
- Wattstopper: www.wattstopper.com

Green Power Resource:

For a listing of green power sources, see: www.green-e.org/energy

- Bullfrog Power: Bullfrog sources power exclusively from generators who meet or exceed the federal governments Environmental Choice Program EcoLogo^M standard for renewable electricity. <http://bullfrogpower.com>
- Renewable Choice Energy: Offers a range of green energy sources including 100% Canadian sourced and typically lower cost American sourced options. www.renewablechoice.com
- 3Degrees: Another reputable company which provides a variety of green energy sources from various sources and at various price points. www.3degreesinc.com/

Recycled Content, Regional Materials, and Rapidly Renewable Materials Resources:

- BuildingGreen.com: www.buildinggreen.com/menus/leedList.cfm
- EPA Environmentally Preferable Purchasing: www.epa.gov/opptintr/epp/
- Good to Be Green: www.goodtobegreen.com
- Green Building Pages: www.greenbuildingpages.com/manufacturers/ProductSearch.php
- Greener Building: www.armstrong.com/resram/na/linoleum/en/us
- Columbia Bamboo Plywood: www.columbiaforestproducts.com
- Eco-Friendly Flooring: www.ecofriendlyflooring.com
- Ecofinishes: www.ecofinishes.com
- EnvironBiocomposites engineered panel products: www.environbiocomposites.com
- Expanko Cork Flooring: www.expanko.com
- Forbo Flooring Systems linoleum products: www.forbo-flooring.com
- Globus Cork: www.corkfloor.com
- GreenSage bamboo products: www.greensage.com
- Kirei bamboo and wheatboard products: www.kireiusa.com
- Plyboo bamboo products: www.plyboo.com
- Sustainable Flooring bamboo and cork products: www.sustainableflooring.com

Certified Wood Resources:

- DuroDesign FSC flooring: www.duro-design.com
- Eco-Friendly Flooring: www.ecofriendlyflooring.com/woods.html
- Knoll FSC Modular Office Furniture: www.knoll.com
- Neil Kelly FSC Cabinets: www.neilkellycabinets.com
- Sustainable Flooring: www.sustainableflooring.com/index.php?index=certified

Low VOC Material Resources:

- AFM SafeCoat: www.afmsafecoat.com
- Benjamin Moore: <http://www.benjaminmoore.com/en-us/for-architects-and-designers/green-promise-environmentally-friendly-paint>
- Find a certified paint through Green Seal: www.greenseal.org/findaproduct/paints_coatings.cfm
- Sherwin Williams: www.sherwin-williams.com/pro/sherwin_williams_paint/product_specifications/leed/index.jsp
- Carpet and Rug Institute (“CRI”) Green Label Plus program: www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus/index.cfm
- CRI Green Label program: www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus/cushion.cfm
- FloorScore: www.rfci.com/int_FS-ProdCert.htm
- InterfaceFLOR: www.interfaceflor.com
- LG Floors: www.lgfloors-usa.com
- Mannington Commercial: www.manningtoncommercial.com
- Crystal Cabinets: www.crystalcabinets.com/GreenProducts.htm
- Haring Doors: www.haringdoors.com/leed.html

Waste Management Resources:

- Halton Region - www.halton.ca/living_in_halton/recycling_waste
- City of Toronto - www.toronto.ca/garbage/index.htm
- Web Based - Buy and Sell of Recycling materials - www.recycle.net/
- California Integrated Waste Management Board C&D Recycling Toolkit for Contractors: www.ciwmb.ca.gov/ConDemo/Toolkit/default.htm

- Construction Materials Recycling Association database of recyclers: www.cdrecycling.org/find.html and Master Specifications for C&D recycling: www.ciwmb.ca.gov/ConDemo/Specs/CMRA.htm
- Recycling C&D Wastes: A Guide for Architects and Contractors: www.mass.gov/dep/recycle/reduce/cdrguide.pdf
- Seattle/King County Contractors' Guide for job-site recycling and waste prevention: www.recyclecddebris.com/rCDd/Resources/Documents/CSRContractorsGuide.pdf
- Whole Building Design Guide database of recyclers: www.wbdg.org/tools/cwm.php and CWM resource page: www.wbdg.org/resources/cwmgmt.php

9. TAKING IT TO THE NEXT LEVEL

If your organization wishes to further demonstrate its commitment to sustainable office interiors, consider certification of your interior renovations to the LEED® Canada for Commercial Interiors (LEED CI) rating system offered by the Canada Green Building Council (CaGBC).

A LEED certified space has numerous benefits. Studies⁴ have shown that LEED spaces have on average:

- 25% less energy use
- 19% lower operating costs
- 27% higher occupant satisfaction

A number of the requirements of LEED CI are incorporated into the required sections of this guide, and many of the recommended stretch targets align with LEED CI credits. Depending on the number of recommended measures implemented, only minimal additional effort may be required to plan your renovation to be LEED compliant. Below is a summary of how the required and recommended targets compare to LEED-CI prerequisites and credits.

Detailed information available at <http://www.cagbc.org/>.

Of paramount importance is to ensure your consultants are LEED Accredited Professionals (LEED APs) with experience in LEED accreditation programs to alleviate costs that can be associated with their learning curve.

⁴ GSA Public Buildings Service, 2011. Green Building Performance, A Post Occupancy Evaluation of 22 GSA Buildings. www.gsa.gov/graphics/pbs/Green_Building_Performance.pdf

Topic	Bentall Kennedy Tenant Green Design Guide			Related LEED Canada CI credit or prereq
Water Efficiency	REQUIRED	Water	Low flow water fixtures	WEc1.1
	RECOMMENDED	Water	Lower flow water fixtures	WEc1.2
Energy Efficiency	REQUIRED	Lighting	New lighting must be no more than 10.06 W/m ² (0.935 W/ft ²)	EAc1.1 (1 point)
			One lighting control strategy using occupancy or daylight sensors	EAc1.2
		Energy	HVAC and lighting to comply with ASHRAE Standard 90.1-2007	EAp2
		Refrigerants	No new CFCs; existing CFCs must have phase-out plan	EAp3
		Equipment	Install only Energy Star rated equipment and appliances	EAc1.4
	RECOMMENDED	Lighting	Provide lighting controls (desk lamps) to 90% of occupants	EQc6.1
			New lighting to be more efficient than the above requirement	EAc1.1 (points 2-3)
		Refrigerants	No new equipment to use HFCs	
		Measurement	Install metering to measure and record utility consumption	EAc3
		Commissioning	Engage a commissioning authority	EAp1 / EAc2
		Green Power	Offset 50% of annual electricity with offsite green power purchase	EAc4
Healthy & Environmentally Friendly Interiors	REQUIRED	New Materials	Recycled content (post + ½ pre) is at least 10%	MRC4.1
			CRI Green Label+ Carpet and FloorScore hard flooring	EQc4.3
		Recycling	Recycling and organics bins wherever waste bins are provided	MRp1
		Paints	Use low VOC paints, sealants, coatings, and adhesives	EQc4.1-4.2
		Composites	Composite wood must not contain added urea-formaldehyde	EQc4.4
		Indoor Air	Air quantities as per Sections 4 through 7 of ASHRAE 62.1-2007	EQp1
		Comfort	HVAC designed to meet ASHRAE 55-2004	EQc7.1
	RECOMMENDED	New Materials	Recycled content (post + ½ pre) is at least 20%	MRC4.2
			10% extracted and 20% manufactured regionally	MRC5
			50% of wood based materials to be from FSC wood	MRC7
			5% of materials to be rapidly renewable	MRC6
		Layout	Locate open work spaces and offices around perimeter	EQc8
		Furniture	Specify Greenguard Certified furniture	EQc4.5
		Comfort	Provide thermal controls to 50% of occupants	EQc6.2
		Pollutants	Specialty ventilation, entrance mats, high efficiency filters	EQc5
		Cycling	Secure bike storage for 5% of employees, showers for 0.5%	SSc3.2
		During Construction or Renovation	REQUIRED	Waste
IAQ	Implement an IAQ construction plan			EQc3.1
RECOMMENDED	Waste		Divert at least 75% of waste from disposal in landfills	MRC2.2
	Reuse		Reuse 40-60% of floors, walls, ceilings	MRC1.2 & 1.3
			Reuse 5-10% of materials (not including furniture)	MRC3.1 & 3.2
			Reuse 30% of furniture	MRC3.3
	IAQ		Develop IAQ pre-occupancy plan (flush-out or testing)	EQc3.2

SCHEDULE 1: LEED-CI SUMMARY

What is LEED?

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ is a voluntary, consensus-based national rating system that encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria.

LEED Basic Facts

- LEED is implemented by the Canadian Green Building Council for the Canadian market and by the U.S. Green Building Council for the United States market which are not for profit and non profit organizations respectively
- LEED is a point-based system for rating the environmental performance of buildings
- Ratings of CERTIFIED, SILVER, GOLD or PLATINUM are awarded based on the number of points a project achieves
- LEED includes a third-party review and certification process
- There are several versions of LEED, each addressing different building types and construction scopes

LEED –CI

LEED for Commercial Interiors is the green benchmark appropriate for the tenant improvement market. It is the recognized system for certifying high-performance green interiors that: are healthy, productive places to work; are less costly to operate and maintain; and have a reduced environmental footprint. LEED–CI provides a framework to make sustainable choices to tenants and designers who do not occupy whole buildings.

LEED–CI addresses the following categories of environmental performance, which are explained in more detail in the sections that follow:

- Sustainable Sites
- Water Efficiency
- Energy & Atmosphere
- Materials & Resources
- Indoor Environmental Quality
- Innovation in Design

Sustainable Sites

This section looks at the environmental choices in terms of the site, its surroundings and certain aspects of the base building in which the LEED–CI project is taking place. A number of the issues addressed in this section may be outside of the scope of influence of the tenant. Within Sustainable Sites, LEED–CI addresses environmental performance in areas such as the reuse of brownfield sites, stormwater management, heat island effect, on-site renewable energy and transportation management.

Water Efficiency

Points for water efficiency are awarded to project teams for their reduction in potable water use relative to standard practice. Low flow fixtures such as toilets, showers and faucets all contribute towards these points.

Energy & Atmosphere

Energy conservation may be the most important way to reduce the negative environmental impact of buildings, since energy use is implicated in resource depletion, global warming and air pollution to name but a few impacts.

To reflect the importance of this section, it contains three prerequisites – mandatory measures that must be completed in order to obtain any level of LEED certification. These are:

- Fundamental Commissioning – to ensure that testing procedures are conducted before tenant occupancy
- Minimum Energy Performance – to ensure compliance with energy code standards
- CFC Reduction – to ensure the avoidance of ozone depleting CFCs in mechanical equipment

LEED rewards projects with points for meeting or exceeding energy efficiency standards for lighting, HVAC and appliances. Points are also available for electricity from green sources, energy metering and enhanced commissioning.

Materials and Resources

The energy and resources required to extract, manufacture and transport building materials have significant environmental impacts. To reduce these impacts, the design team should emphasize the use of materials that have a minimal environmental impact and low embodied energy.

This section has one prerequisite – the provision of space for storing recyclables in the finished project – and also assesses the recycled content, reused content and locality of the materials used. Points are also available for diverting construction waste from landfill and selecting sustainable materials such as FSC certified wood or rapidly renewable materials such as bamboo.

Indoor Environmental Quality

Earth-conscious building design doesn't stop at the building entrance, but includes issues related to the indoor environment: air quality, natural lighting and outdoor views. Healthy workspaces mean healthy, happy and productive staff with reduced absenteeism; many measures in this section make commercial sense too.

All projects must comply with two prerequisites in this section – tobacco smoke control and ventilation rates in accordance with or better than minimum standards.

Beyond that, LEED encourages a healthy working environment in two ways. First, LEED awards project points for minimizing harmful substances such as pollutants from construction process and harmful substances (particularly VOCs) in materials, paints, sealants and furniture. Second, LEED recognizes design features that actively contribute toward health and well being, namely natural day lighting, views out and comfortable and controllable heating, ventilation and lighting systems.

Innovation in Design

The final section allows projects to be rewarded for innovation measures not covered elsewhere in LEED or to achieve points by demonstrating “exceptional performance” in one of the areas covered by LEED.