Sustainability Assessment of the Palm Springs Spa Resort Hotel

100 North Indian Canyon Drive
Palm Springs, CA 92262

Prepared for:

Palm Springs Preservation Foundation
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1. INTRODUCTION

The Palm Springs Preservation Foundation (PSPF) recently asked Ecotype Consulting to prepare this report to analyze the embodied energy contained within the Spa Resort Hotel structure and envelope, and to estimate the environmental effects of demolition. The Spa Resort Hotel is owned by the Agua Caliente Band of Cahuilla Indians (the Band). The hotel is located at the northeast corner of Tahquitz Canyon Drive and Indian Canyon Drive directly adjacent to, and drawing from, the historic Agua Caliente Spring.

Although sustainability is generally considered to be the nexus between ecological, economic, and cultural concerns, it is beyond the scope of this study to compare the economic and cultural aspects of the Spa Resort Hotel demolition. The cultural relevance of the hotel has been addressed in numerous documents and publications, most recently in the May 8, 2014 letter from PSPF to the Chairman on the Tribal Council for the Agua Caliente Band of Cahuilla Indians. The economic relevance of the hotel has presumably been thoroughly investigated by the Tribe. This document is intended to serve as a counterpart, rather than a counter*point*, to those analyses, in order to provide tribal leadership and private investors with a more comprehensive picture of the relative sustainability of the project.

In regards to *ecological* sustainability, this study will clearly demonstrate that demolition of the hotel complex will result in considerable embodied energy losses, energy consumption, landfill, and greenhouse gas emissions. Lacking a proposed project to compare it to, we are unable to definitively determine whether preservation or new construction would present the fewest environmental impacts. That question would be answered with a comparative study once a proposed project is determined for the site. However, the metrics and/or principles of life cycle analysis and embodied energy for the existing building should be considered in the event that the Band wishes to mitigate environmental impacts of the project. It is my sincere hope that these results will be considered and given the same weight as the economic and cultural considerations for whichever project is ultimately implemented.

Eric R. Shamp, AIA, NCARB, LEED AP
Principal, Ecotype Consulting
July 2014

2. EXECUTIVE SUMMARY

In this study, we developed a numerical model of the Spa Resort Hotel building using a life-cycle analysis tool, in order to determine the likely environmental costs in demolishing the facility. All data regarding sizes, types, quantities, and conditions of materials contained in the building are based on observation, rough estimates, and our professional judgment.

We have arrived at the following findings:

- The energy embodied in the building represents all of the energy already invested in the construction and operation of the building up to this point. For this facility, embodied energy is 97,400,000 megajoules. This represents a global warming potential of 7,613 metric tonnes of greenhouse gas emissions, and is the equivalent to the emissions of 4,088 tons of coal.

- The building was built at considerable environmental cost. It is helpful to think of that environmental cost as a debt. The longer a financial debt is amortized, the easier it is to manage the debt payments. Similarly, the longer a building's life-span, the easier it is to mitigate the environmental cost.

- Demolition of the building will add an additional 375 metric tonnes of greenhouse gas emissions, the equivalent emissions of 201 tons of coal.

- More than 80% of the demolition waste will consist of concrete rubble. Concrete rubble is used for base material, alternative daily cover in landfills, and both temporary and permanent erosion control. It is a low-value material, valued only for its mass and water permeability. Rather than re-cycled, concrete is more correctly down-cycled, in that the material cannot serve its original purpose and loses most of its value once demolished.

- Only 9% of the demolition waste is anticipated to be truly recyclable material, consisting mostly of metals and salvaged architectural details.

- A complete teardown and reconstruction of a similar sized building on the site will result in more than four times as much construction and demolition debris when compared to an extensive rehabilitation of the existing building.

3. SUSTAINABILITY AND HISTORIC PRESERVATION

3.1 Definition of sustainability

Sustainable development can best be described using a definition developed by the UN World Commission on the Environment in 1987: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[1]. This definition is quite broad in its application, with no specific reference to any category or aspect of conservation. In common practice, however, this definition is generally understood by the progressive business and development community to apply to a continuity of economic, ecological, and cultural conditions that support human society.

These economic, ecological, and cultural conditions are known collectively as the "triple bottom line"[2] of sustainable development. In order to produce the most sustainable outcome from any development project, all three conditions are to be given equal consideration. The "triple bottom line" concept distinguishes traditional economic development from *sustainable* economic development.

3.2 The Band's Commitment to Sustainability

The Agua Caliente Band has demonstrated a commitment towards sustainability by establishing a Tribal Environmental Policy Act. This ordinance sets policy for sustainable development of Tribal Property. It is a bold statement that declares:

> It is the policy of the Agua Caliente Band of Cahuilla Indians to protect the natural environment, including the land, air, water, minerals, and all living things, on or directly affected by the use and development of Tribal Property.[3]

The Policy sets broad environmental goals, establishes environmental reviews for projects, and requires mitigation measures to offset environmental effects. We offer this analysis to the Band in the hope that it will be considered during the environmental review process for any future project on the hotel site.

3.3 Nexus between sustainability and historic preservation

There is a significant alignment between the movement to preserve historic structures and sustainable development. The construction of a new building represents a significant economic investment in material and energy resources, along with

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[1] The World Commission on Environment and Development, *Our Common Future*, (New York: Oxford University Press, 1987), 43.

[2] Originally coined by John Elkington, *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*, (London: New Society Publishers, 1998).

[3] Agua Caliente Band of Cahuilla Indians, Tribal Ordinance No. 28, Tribal Environmental Policy Act, Section II.A.

ecological impacts associated with raw material extraction, manufacturing, transportation, fossil fuel extraction, and fuel consumption. The demolition of an existing building (whether historic or not) results in a total loss of those economic and ecological resources, and further compounds the ecological impacts of a construction project.

Washington DC architect Carl Elefante, FAIA, LEED AP describes building reuse thus, "The greenest building is the one that's already built." According to one study[4], 39% of the total energy consumption over the life span of a typical building is embodied in its materials. By retaining an existing building, the embodied energy is amortized over a greater time span, dramatically reducing the size of the building's ecological footprint.

Historic structures tend to be especially good candidates for rehabilitation as "green" buildings. In contrast with the majority of contemporary buildings, historic buildings are often designed for passive thermal comfort, are built using more durable materials and construction techniques, and are sited in a way that prioritizes pedestrian access over vehicular traffic. With a few discrete improvements to a historic building's exterior envelope (infiltration control, thermally-efficient windows, cool roofing), a historic building can be made quite energy efficient.

3.4 Types of historic resource reuse and implications for sustainable development

Although the hotel is not itself a designated historic structure, it is equal in quality, style, and vintage to other historic-designated properties in Palm Springs. It is therefore instructive to define the different types of historic preservation, and how each type con allow for green building upgrades to the existing structure. The US Department of the Interior recognizes several standard treatments of historic properties[5]:

> **Preservation.** The standard for historic preservation requires the application of measures intended to "stabilize, consolidate, and conserve" historic features. The property must be used for its original historic purpose, or used in a manner that does not require significant change to the defining characteristics of the building. Only deteriorated or missing portions of the building may be built; no new additions are allowed. This approach would allow some energy efficiency upgrades, as long as they did not disrupt the historic character of the building. This approach may not provide the required design flexibility to make the project economically feasible, and may limit the ability to make energy efficiency and sustainability upgrades.

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[4] Mike Jackson, "Embodied Energy and Historic Preservation: A Needed Reassessment", Journal of Preservation Technology 36:4, (2005).

[5] Kay Weeks and Anne E. Grimmer, The Secretary of the Interior's Standards for the Treatment of Historic Properties, (Washington DC, National Park Service, 1995).

Rehabilitation. In summary, this standard requires that a property be used for its historic purpose, or used in a manner that does not require significant change to the defining characteristics of the building. There shall be no removal or alteration of historic materials, features, or spaces. Deteriorated features are repaired rather than replaced. New additions are allowed, but must be distinguishable from the historic portions of the property. This approach would allow most energy efficiency upgrades, as long as they did not disrupt the historic character of the building. This approach gives the flexibility to make major repairs, alterations, and/or additions.

Restoration. This is defined as "the act or process of accurately depicting the form, features, and character of a property as it appears at a particular period of time". This approach is typically selected in cases where a historic structure is intended to be used for the demonstration a significant period of time for educational purposes. It is the most restrictive approach, and would not be appropriate to suit the ongoing economic sustainability of the site.

Adaptive Reuse. This approach is not formally recognized by the US Department of the Interior as an official standard for the treatment of historic properties. Adaptive reuse is the process of dramatically changing the historic use of a property, especially after the original use is obsolete. This can often require significant architectural changes, or even the co-opting of a historic structure within a new structure. It is generally infeasible to perform an adaptive reuse on a precast concrete hotel structure.

In 2011, the US Department of the Interior published *The Secretary of the Interior's Standards for Rehabilitation & Illustrated Guidelines on Sustainability for Rehabilitating Historic Buildings*[6]. If the Band were to consider some form of preservation of the building, this document would assist in guiding that process.

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[6] Anne E. Grimmer, Jo Ellen Hansley, Liz Petrella, and Audrey T. Tepper, *The Secretary of the Interior's Standards for Rehabilitation & Illustrated Guidelines on Sustainability for Rehabilitating Historic Buildings*, (Washington DC, National Park Service, 2011).

4. EMBODIED ENERGY COMPARISONS

4.1 Definition of embodied energy

Embodied energy is defined as the amount of energy required to extract, manufacture, transport, install, use, decommission, and dispose of a material or an assembly of materials. In 2005, architect Mike Jackson, FAIA, published an article in the *Journal of Preservation Technology*[7] asserting that the ratio of embodied energy to annual operating energy in an existing building ranges from 5:1 to 30:1. In other words, it takes 5 to 30 years of operation to consume the same amount of energy as is embodied in the materials. Considering that most contemporary buildings are constructed with a 25 year lifespan in mind, many new buildings have more energy invested in the materials than in their operation over the entire lifespan.

Furthermore, when we consider that fossil fuels make up 86.4% of the world's primary energy consumption,[8] it becomes apparent that the embodied energy of building materials is a significant source of greenhouse gas (GHG) emissions. According to an analysis[9] of 2009 data from the US Energy Information Administration, buildings consume almost half of all energy produced in the US. Buildings are by far the biggest single contributor to US GHG emissions.

Any serious policy effort to address the reduction of GHG emissions must prioritize the reduction of energy consumption by the building sector. Embodied energy is as significant a contributor of GHG emissions as operational energy, yet the development industry in California continues to demolish usable and economically feasible buildings with little concern for the ecological and long-term economic impacts.

4.2 Methodology and assumptions

In order to measure the embodied energy and environmental impacts of the Spa Resort Hotel and its demolition, we use a tool recently developed by the Athena Sustainable Materials Institute, a non-profit research collaborative dedicated to researching building life-cycles and developing tools used to determine and quantify the environmental impacts of a building project[10]. The Athena Impact Estimator for Buildings provides estimates of environmental impacts based on rough take-offs of building structural and envelope systems. Environmental impact datasets are developed by the Athena Institute, which are described in downloadable reports from the Athena Institute website. We do not consider lighting, HVAC, low-voltage systems,

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[7] Jackson, p. 51.

[8] US Energy Information Administration International Energy Statistics, 2007.

[9] Analysis by architect Ed Mazria for Architecture 2030, in which traditional energy data reporting classifications are re-allocated to create a single Building Sector (www.architecture2030.org/the_problem/buildings_problem_why)

[10] See www.athenasmi.org for more information.

conveyances, or interior finishes, due to the fact that upgrades to these systems are typically non-elective projects that result in reduced operations, maintenance, and utility costs, and because these systems are typically replaced at least once during the normal life-cycle of a building.

4.3 Interpreting the results

Care should be taken in interpreting the summary data below. The data is affected by the following limitations:

1. Datasets of environmental impacts are proprietary to the Athena Institute. The Institute is transparent about how the datasets are collected, but they do not publish the datasets themselves.
2. Datasets are derived from recent research, but the hotel construction was completed in 1960. It is safe to assume that actual environmental impacts related to construction would be considerably higher if improvements in fuel, source energy, and process efficiencies over the last half-century were considered.
3. Building quantity take-offs were visually estimated both onsite and using Google Earth Pro. There are inaccuracies inherent in this method of visual estimation of building materials. We believe that our estimates are within +/- 20% of actual.
4. Absent testing and/or record documents, we used our professional judgment to propose concrete structural strength, thickness, and reinforcing.

See the Appendices for detailed input and output reports generated by the *Impact Estimator* software.

4.4 Summary of effects by life cycle stage

Life cycle stage	Global warming potential (in tonnes of CO2 equivalent)[11]	Tons of coal, equivalent CO2 emissons[12]	Total primary energy (MJ)[13]	Approx size of equivalent photovoltaic array, operating for 25 years[14]
Building product mfr'ing and transport	5,810	3,120	7.13E+07	500 kW
Construction process	1,250	671	1.61E+07	115 kW
Replacement over time, mfr'ing, transport, and installation	553	297	1.00E+07	70 kW
Total embodied	7,613	4,088	9.74E+07	685 kW
Demolition, landfill and recycling	375	201	5.38E+06	9 kW

The embodied energy contained in the project would approximately require a ¾ megawatt photovoltaic solar array, requiring 100,000 square feet of unshaded area, operating at full capacity for 25 years to offset it.

4.5 Summary of demolition waste

Appendix A "Bill of Materials Report" summarizes the material quantity estimates used in the life cycle analysis. This can be used as a starting point for calculating demolition waste. This estimate includes building, pedestrian hardscape, constructed site features. For a more thorough estimate of demolition waste, we have to estimate additional materials not included in the life cycle analysis. This includes finish materials and mechanical, electrical, and plumbing systems. These materials tend to have much lower diversion rates.

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[11] See Appendix B, "Detailed Summary Measure Table By Life Cycle Changes".

[12] US EPA Greenhouse Gas Equivalencies Calculator, www.epa.gov/cleanenergy/energy-resources/calculator.html.

[13] See Appendix B.

[14] To calculate PV system size equivalence, we converted MJ to kWh, then used National Renewable Energy Laboratory PV Watts calculator for a fixed solar array located in Palm Springs to determine annual output in kW.

On most demolition projects, it is common to divert 75-95% of demolition waste from landfill, by sorting and hauling materials to material reclamation centers. In the table below, we separate materials that are typically recyclable in order to determine the maximum theoretical diversion rate. This maximum rate is typically reduced by the presence of hazardous substances that can make material unrecyclable and by mismanagement of materials.

The bulk of the recyclable material will consist of concrete rubble. The structure and exterior skin of the entire facility consists of precast concrete, cast-in-place concrete, and concrete block. This material, if left in place, represents the greatest investment in embodied energy and greenhouse gas emissions, and potentially has the longest lifespan.

It is important to distinguish between degrees of recycling. Many recyclable materials are re-processed back into their previous uses, and thereby offset the extraction and processing of new raw materials. These materials include aluminum, steel, paper, and many plastics. Concrete, however, is more correctly “down-cycled”. The use of concrete rubble does not offset the new extraction and processing of concrete.

Demolition material	Weight [tons]	% of total	Volume [cubic yards][15]	Truckloads (@ 40 cy ea)
Non-recyclable materials	2,988.3	9.3	17,076	427
Recyclable materials	3,090.7	8.8	17,661	442
Concrete rubble	29,055.5	81.9	41,508	1038
Total Demolition Waste	**35,134.5**		**76,245**	**1907**

For reference, a complete teardown and reconstruction of a similar sized building on the site typically results in more than four times as much construction and demolition debris when compared to an extensive rehabilitation of the existing building.

End of Report

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[15] Calculated using solid waste conversion factors described in the *LEED Reference Guide for Green Building Design and Construction*, p.360.

APPENDIX A

Bill of Materials Report

Project: Spa Resort Hotel

Material	Unit	Total Quantity	Columns & Beams	Floors	Foundations	Roofs	Walls	Extra Basic Materials	Mass Value	Mass Unit
#15 Organic Felt	100sf	4793.8569	0	0	0	4771.0561	22.8007	0	35.8277	Tons (short)
1/2" Fire-Rated Type X Gypsum Board	sf	55756.7978	0	0	0	0	55756.7978	0	46.7073	Tons (short)
1/2" Gypsum Fibre Gypsum Board	sf	324675.9861	0	184139.9929	0	0	140535.9932	0	372.3937	Tons (short)
8" Concrete Block	Blocks	59927.6157	0	0	0	0	59927.6157	0	1255.1185	Tons (short)
Aluminum Window Frame	lbs	21136.0742	0	0	0	0	21136.0742	0	10.5680	Tons (short)
Ballast (aggregate stone)	lbs	947381.3356	0	0	0	947381.3356	0	0	473.6911	Tons (short)
Blown Cellulose	sf (1")	87951.7892	0	0	0	87951.7892	0	0	5.7645	Tons (short)
Cold Rolled Sheet	Tons (short)	0.0165	0	0	0	0	0.0165	0	0.0165	Tons (short)
Concrete 20 MPa (flyash av)	yd3	7794.1872	0	0	2065.9056	3268.9612	2459.3204	0	15272.3706	Tons (short)
Concrete 30 MPa (flyash av)	yd3	7034.2298	274.7544	6537.9224	0	221.5530	0	0	13783.2673	Tons (short)
Double Glazed No Coating Air	sf	105679.6670	0	0	0	0	105679.6670	0	175.2493	Tons (short)
Expanded Polystyrene	sf (1")	350.3653	0	0	0	0	350.3653	0	0.0258	Tons (short)
Galvanized Sheet	Tons (short)	10.8960	0	0	0	10.2135	0.6825	0	10.8960	Tons (short)
Joint Compound	Tons (short)	38.8822	0	18.8200	0	0	20.0621	0	38.8822	Tons (short)
Mortar	yd3	1496.1366	0	0	0	0	1496.1366	0	1613.9641	Tons (short)

APPENDIX A

Bill of Materials Report

Project: Spa Resort Hotel

Nails	Tons (short)	4.8007	0	0.1766	0	4.4143	0.2098	0	4.8007	Tons (short)
Natural Stone	sf	840.0000	0	0	0	0	840.0000	0	6.4868	Tons (short)
Paper Tape	Tons (short)	0.4463	0	0.2160	0	0	0.2303	0	0.4463	Tons (short)
Rebar, Rod, Light Sections	Tons (short)	1807.7628	77.6574	286.1311	17.1552	152.6025	1274.2166	0	1807.7628	Tons (short)
Roofing Asphalt	lbs	288332.3943	0	0	0	288332.3943	0	0	144.1663	Tons (short)
Solvent Based Alkyd Paint	Gallons (us)	4557.2528	0	0	0	0	4557.2528	0	14.2620	Tons (short)
Type III Glass Felt	100sf	9542.1122	0	0	0	9542.1122	0	0	51.3297	Tons (short)
Welded Wire Mesh / Ladder Wire	Tons (short)	10.5042	0	0	10.5042	0	0	0	10.5042	Tons (short)

APPENDIX B

Detailed Summary Measure Table By Life Cycle Stages

Project: Spa Resort Hotel

		PRODUCT (A1 to A3)			**CONSTRUCTION PROCESS (A4 & A5)**			**USE (B2, B4 & B6)**		
Summary Measure	**Unit**	Manufacturing	Transport	**Total**	Construction-Installation Process	Transport	**Total**	Replacement Manufacturing	Replacement Transport	Opera Energ To
Global Warming Potential	kg CO2 eq	5.61E+06	1.94E+05	**5.81E+06**	4.54E+05	7.95E+05	**1.25E+06**	5.00E+05	5.30E+04	0.
Acidification Potential	kg SO2 eq	2.62E+04	1.80E+03	**2.80E+04**	2.87E+03	7.92E+03	**1.08E+04**	3.94E+03	5.45E+02	0.
HH Particulate	kg PM2.5 eq	1.70E+04	1.05E+02	**1.71E+04**	6.37E+02	4.42E+02	**1.08E+03**	1.05E+03	3.00E+01	0.
Eutrophication Potential	kg N eq	6.45E+02	1.23E+02	**7.68E+02**	1.39E+02	5.38E+02	**6.77E+02**	2.70E+03	3.69E+01	0.
Ozone Depletion Potential	kg CFC-11 eq	4.31E-02	7.09E-06	**4.31E-02**	2.15E-03	3.08E-05	**2.18E-03**	1.12E-02	2.13E-06	0.
Smog Potential	kg O3 eq	2.91E+05	6.27E+04	**3.54E+05**	7.62E+04	2.76E+05	**3.52E+05**	3.10E+04	1.90E+04	0.
Total Primary Energy	MJ	6.87E+07	2.53E+06	**7.13E+07**	5.32E+06	1.08E+07	**1.61E+07**	9.28E+06	7.20E+05	0.
Non-Renewable Energy	MJ	6.79E+07	2.53E+06	**7.04E+07**	5.28E+06	1.08E+07	**1.61E+07**	9.03E+06	7.20E+05	0.
Fossil Fuel Consumption	MJ	5.43E+07	2.52E+06	**5.69E+07**	5.12E+06	1.08E+07	**1.59E+07**	8.81E+06	7.18E+05	0.

Detailed Summary Measure Table By Life Cycle Stages

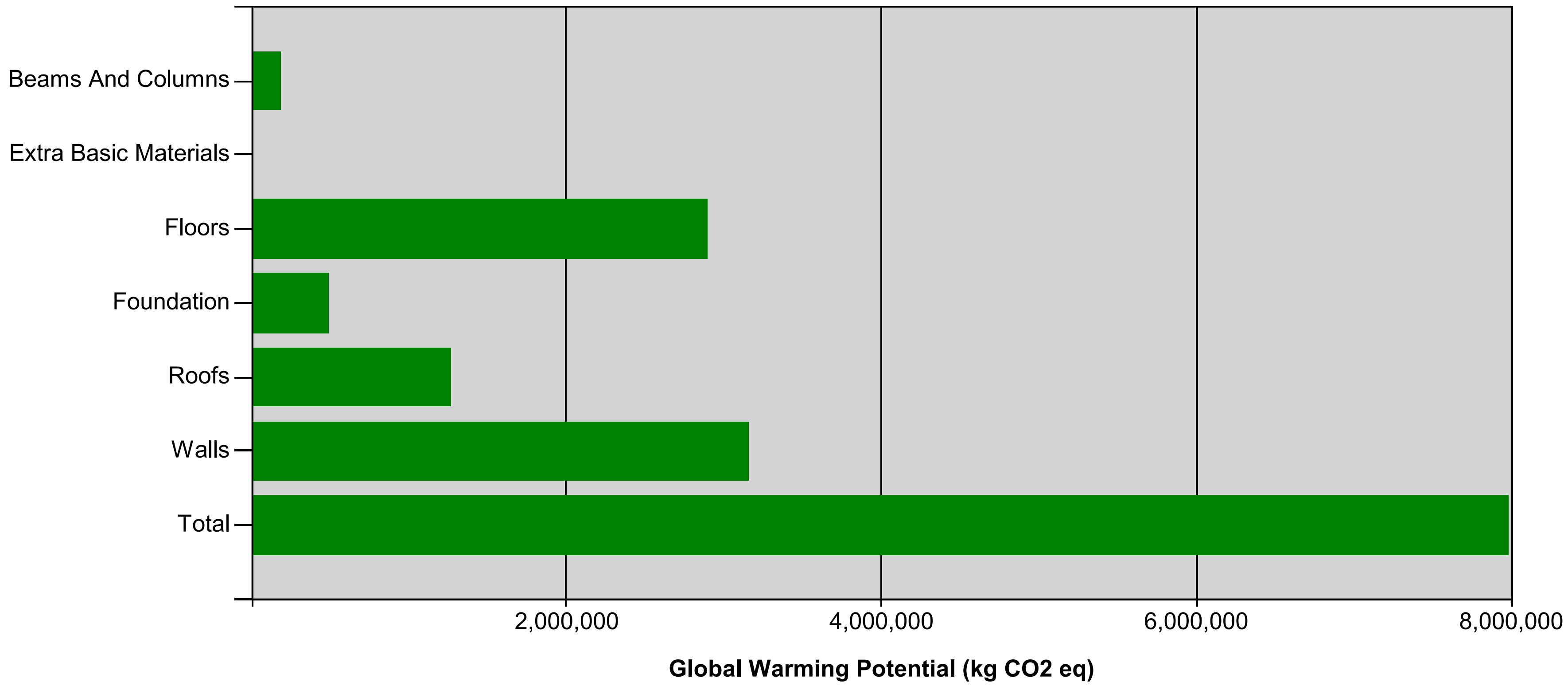
Project: Spa Resort Hotel

USE (B2, B4 & B6)		END OF LIFE (C1 to C4)			BEYOND BUILDING LIFE (D)			TOTAL EFFECTS	
tional y Use tal	**Total**	De-construction, Demolition, Disposal & Waste Processing	Transport	**Total**	BBL Material	BBL Transport	**Total**	**A to C**	**A to D**
00E+00	**5.53E+05**	2.55E+05	1.20E+05	**3.75E+05**	0.00E+00	0.00E+00	**0.00E+00**	**7.98E+06**	**7.98E+06**
00E+00	**4.49E+03**	3.06E+03	1.09E+03	**4.15E+03**	0.00E+00	0.00E+00	**0.00E+00**	**4.75E+04**	**4.75E+04**
00E+00	**1.08E+03**	2.18E+02	6.51E+01	**2.84E+02**	0.00E+00	0.00E+00	**0.00E+00**	**1.95E+04**	**1.95E+04**
00E+00	**2.74E+03**	1.93E+02	7.42E+01	**2.67E+02**	0.00E+00	0.00E+00	**0.00E+00**	**4.45E+03**	**4.45E+03**
00E+00	**1.12E-02**	9.94E-06	4.32E-06	**1.43E-05**	0.00E+00	0.00E+00	**0.00E+00**	**5.65E-02**	**5.65E-02**
00E+00	**5.00E+04**	1.02E+05	3.77E+04	**1.40E+05**	0.00E+00	0.00E+00	**0.00E+00**	**8.95E+05**	**8.95E+05**
00E+00	**1.00E+07**	3.91E+06	1.47E+06	**5.38E+06**	0.00E+00	0.00E+00	**0.00E+00**	**1.03E+08**	**1.03E+08**
00E+00	**9.75E+06**	3.85E+06	1.47E+06	**5.32E+06**	0.00E+00	0.00E+00	**0.00E+00**	**1.02E+08**	**1.02E+08**
00E+00	**9.53E+06**	3.81E+06	1.46E+06	**5.28E+06**	0.00E+00	0.00E+00	**0.00E+00**	**8.76E+07**	**8.76E+07**

APPENDIX C

Global Warming Potential Summary Measure Chart By Assembly Groups (A to D)

Project: Spa Resort Hotel



Global Warming Potential Summary Measure Chart By Assembly Groups (A to D)

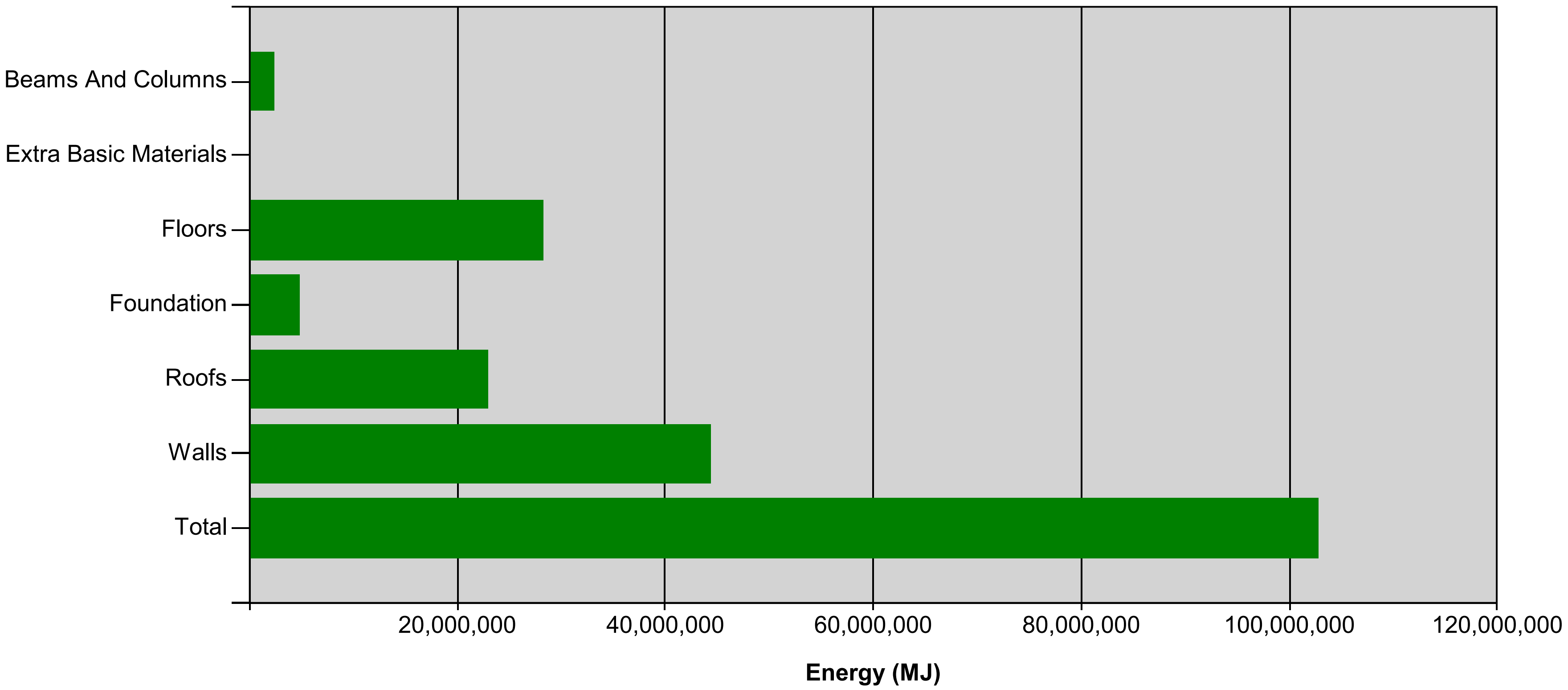
Project: Spa Resort Hotel

Assembly Group	Unit	Total
Beams And Columns	kg CO2 eq	1.87E+05
Extra Basic Materials	kg CO2 eq	0.00E+00
Floors	kg CO2 eq	2.89E+06
Foundation	kg CO2 eq	4.83E+05
Roofs	kg CO2 eq	1.27E+06
Walls	kg CO2 eq	3.16E+06
Total	**kg CO2 eq**	**7.98E+06**

APPENDIX D

Total Primary Energy Summary Measure Chart By Assembly Groups (A to D)

Project: Spa Resort Hotel



Total Primary Energy Summary Measure Chart By Assembly Groups (A to D)

Project: Spa Resort Hotel

Assembly Group	Unit	Total
Beams And Columns	MJ	2.40E+06
Extra Basic Materials	MJ	0.00E+00
Floors	MJ	2.83E+07
Foundation	MJ	4.80E+06
Roofs	MJ	2.29E+07
Walls	MJ	4.44E+07
Total	**MJ**	**1.03E+08**