

Rwanda Community Works

Triple Bottom Line:

Environment, Economy, Society

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Barbara C. Canavan
Harvard Project Team - Rwanda

Background

The genocide in Rwanda deeply affected Bugesera, one of the poorest districts in the country. The climate in this region is prone to droughts. The Rwandan government chose Mayange, Bugesera as the first place to address seemingly unsolvable problems of poverty, access to basic health care, and environmental degradation (Ruxin, 2007). The Millennium Village and Access Projects provided interventions in health, agriculture, environment, and education in Bugesera. Based on early results from these interventions, it was clear that communities could begin to break the cycle of poverty (Millennium Villages, 2008).

Building on the success of the Millennium Village Project, Rwanda Community Works (RCW) is a non-profit that focuses on access to health care and businesses in the sectors of agriculture, handicrafts and tourism in Bugesera. The RCW Strategic Plan (2008) proposes a lodge for birding and tourism in Bugesera. To be successful, the ecolodge project needs to provide solid benefits to local communities with long-term jobs and transferable skills to benefit people beyond the period of constructing a lodge.

Purpose of this Proposal to Rwanda Community Works

This report provides an initial assessment for the feasibility of building an ecolodge adjacent to a lake in the Bugesera wetlands region. The reports focuses on organizations that work in Rwanda and can assist RCW not only with green building, but also with projects that drive prosperity and improve health. The report describes these organizations, their projects in green technology, renewable energy, clean water systems, and their efforts to support economic self-sufficiency for the people of Rwanda.

Initial Feasibility for Bugesera Ecolodge – Wetlands Ecosystem, Tourism Market

In this pre-design phase of the project, a vision for the ecolodge emerged from the collaborative work of RCW and members of the Harvard project team. The lodge would support a diverse and flexible space to meet both community and visitor needs. Suggested uses for the facility included skill-based training for local workers, a gift shop to display handicrafts, and a lodge for a mid-market audience. All agreed that a luxury lodge would not work without high-end attractions (like Gorillas) in the immediate vicinity. The lodge or tented camp would have renewable energy sources, local materials, and a design that reflects the local culture. Birding and community service are some initial opportunities to build a tourism market in Bugesera. A successful ecolodge in Bugesera must also consider the overall environment, public health, and the potential for local profit and self-sufficiency.

Rwanda supports a high number of Albertine Rift endemic birds and has a bird list of over 670 species, many of which are in Rwanda's protected national parks. The proposed site for the Bugesera ecolodge is adjacent to the Nyabarongo wetlands, consisting of papyrus swamps and marshes. Although Nyabarongo is listed as an Important Bird Area (IBA), an indication of its importance to global biodiversity, the wetland area has no conservation status. Birdlife International (2008) lists the Papyrus Gonolek (*Laniarius mufumbiri*) as Near Threatened. This bird has a moderately small range, and the degradation of wetlands threatens its habitat. The Rwandan birding association would like the southern part of Bugesera, down to the Burundian border, made into a conservation area for bird habitat (R.



Photo: P. Dejace (2005). Papyrus Gonolek (*Laniarius mufumbiri*)

Strohm, personal communication, 11/13/08). This is challenging, as most people in Bugesera live on what they can produce from the land and water resources.

Rwanda is committed to linking tourism, conservation and science (AAAS, 2008). Issues of the environment, economics and society are interrelated through the way humans interact with their surroundings and with each other. For example, pressure on wetlands from human settlements may contribute to the re-emergence of water hyacinth in Africa (Bugenyi & Balirwa, 1998). According to the Pilot Integrated Ecosystem Assessment of Bugesera (United Nations, 2007), water hyacinth is visible in or around all the bodies of water in Bugesera. The mats of water hyacinth, in turn, provide a habitat for insects carrying malaria and other diseases that threaten human health; the mats choke waterways and lakes (Malakata, 2008). Ecotourism experts and environmentalists worry that the water hyacinth may not only pose a threat to health and to biodiversity, but also to tourism in many regions of Africa (Onyango, 2007).

In its natural state, Bugesera is a region that is well endowed with water resources. Wetland ecosystems provide many services to humans (e.g., flood control, ground water recharge); products (fish, crafts, medicines, rich sediments for agriculture); habitat for birds and animals that attract tourists. As there is no protected area in Bugesera, the Pilot Integrated Ecosystem Assessment of Bugesera (United Nations, 2007) recommends appropriate and *realistic* measures to restore or maintain biodiversity in the wetland region. The investigators recommend widespread adoption of rainwater harvesting, but this will largely depend on its affordability to local communities. They suggest developing a rainwater harvesting method that uses more local materials in the



Papyrus Yellow Warbler, resident of Nyabarongo wetlands. Listed as *vulnerable* by Birdlife International (2008).

construction of rainwater storage tanks. Rainwater harvesting is not yet popular in Bugesera, although Mayange has rainwater tanks introduced under the Millennium Villages project. As outlined in the technical feasibility section of this report, organizations with skill in sustainable technology projects in Rwanda may be able to assist with rainwater harvesting alternatives that would be suitable for Bugesera.

It is important to conduct up-to-date bird and wildlife surveys in the Nyabarongo wetlands early in the ecolodge planning process. Results of field research provide an effective tool for environmental sustainability by presenting the best evidence on the economic importance of the environment to poverty reduction. These efforts support RCW's long-term capacity to integrate the environment into its development plans.

An ecolodge could create opportunities for economic enterprise in Bugesera: generally, about one third of tourism dollars go towards local crafts, food and drink vendors, and guides (Pro Poor Tourism, 2008). Linking with volunteer programs prior to the construction of an ecolodge may be one way to build the market and connect Bugesera with a reliable source of visitors for community service and education projects. For example, Global Volunteers collaborates with local leaders to translate development goals into volunteer strategies (Global Volunteers, 2008). They provide on-site management for booking and coordination of volunteers. The Network for Africa indicated they might be able to send volunteers to help teach English in Bugesera (Sophie, personal communication, 12/9/08). Recently, Rwanda decided to switch the country's entire education system from French to English (R. Strohm, personal communication, 11/24/08).

Rwanda is making substantial progress towards improvement of public health and is working to achieve the Millennium Development Goals. Over the next five years, RCW will

build 4 new health centers and 65 village health posts in Bugesera (Rwanda Community Works Strategic Plan, 2008). The supply of safe drinking water is fundamental to disease control for residents and travelers alike. It is important to assess water quality conditions early in the pre-design process. It is noteworthy that hippos and crocodiles inhabit the Bugesera lakes. While it is not a region for water sports, some may consider it a bonus to see a hippo while birding.

One approach for an Ecolodge in Bugesera is to build the facility in phases, with sufficient time to develop the birding market, perhaps starting with an observation tower and raised viewing platforms for bird watching near the lake. It is important that the local community have a voice in potential tourism and can participate from the beginning. In addition, it would be advantageous if the local private tour operators from Kigali could participate in the tourism market development. Some initiatives can run concurrently in the pre-design phase:

- Market research to determine the potential clientele and local benefits
- Environmental impact studies
- Bird surveys to identify bird habitats and populations of endangered, endemic, and resident birds in the Nyabarongo wetlands
- Assess and monitor local water quality
- Build regional infrastructure including water/sanitation systems (United Nations, 2007)
- Integrate environment and energy projects with initiatives to reduce poverty (Sustainable Energy Africa, 2006)

Initial Feasibility for Bugesera Ecolodge – Access to Sustainable Technology and Training

The technical feasibility of an ecolodge project depends on the skill base to implement green technology, clean water, and renewable energy systems in Rwanda. The feasibility of meeting RCW's prosperity goals is also contingent on the transfer of those skills to local people. Rwanda's Vision 2020 calls for direct investment in new Rwandan business ventures (Ministry of Finance and Economic Planning, Rwanda, 2000). Energy projects that are self-sustaining can stimulate economic growth in Bugesera and support prosperity through business development. To mitigate risk in any major project, it is useful to look at existing models that work well, particularly those that work well in Rwanda. This report section focuses on organizations that collaborate on green building, water, and energy projects in Rwanda and can provide value and experience to RCW and to Bugesera. Contact details for all organizations are in Appendix A.

Birambye is Rwandan for "sustainability". Birambye International is a non-profit organization with a mission to assist communities reach their goals of economic self-sufficiency "without sacrificing culture or the environment" (Birambye, 2008). Birambye develops sustainable business projects with their Rwandan partner, the Genocide Survivors Student Association (GSSA), also a non-profit. Rwanda has one of the largest populations of orphans and vulnerable children and youths in the world (Dekkers, 2008). GSSA membership exceeds 10,000 in universities, higher learning institutions, and more than 70 secondary schools. GSSA provides guidance in selecting and managing all Birambye International projects in Rwanda. In addition, GSSA provides invaluable cultural and political insight.

In 2009, Birambye will start construction on the Birambye Ecolodge on the shore of Lake Kivu. The lodge has received approval from the Rwanda Environment Management Authority (REMA). This is an excellent project for RCW's involvement, as the lodge will have similar

features to what RCW envisions for a lodge in Bugesera. The plans feature six cabanas and a lodge, all with economical thin-shelled concrete roofs, renewable bamboo flooring and traditional thatched exteriors. Biogas digesters will turn methane into fuel for cooking, and each cabin will feature solar and wind power and rainwater collection systems (Birambye, 2008). The estimated cost to build the lodge is \$150,000; the land is donated (M. Reiner, personal communication 12/15/08).

Birambye's model is to focus on enterprises that will be sustainable after an initial investment. The main vehicle for Birambye to accomplish this is through local training and workshops in Rwanda (Pecoraro, 2008). Birambye and GSSA will recruit community members to attend technology workshops that include four weeks of training during the construction of the Lake Kivu ecolodge. Professionals will train communities to build and maintain building and energy systems. Birambye and GSSA will measure the project's success across a triple bottom line of economic, social, and environmental factors (Pecoraro, 2008).

Once the lodge is complete, Birambye plans to integrate with the local market in Mugonero to develop trekking and kayak trips (Birambye, 2008). The lodge will provide a docking area and a place to trade and sell. It will be an easy walking commute for local employees. The lodge will employ a minimum of 40 people with 30% occupancy rate; this will help to promote business in Mugonero (Pecoraro, 2008). Birambye plans to advertise for travelers through the newsletter of Sustainable Travel International that reaches 22,000 members, as well as through Rwanda's main tourism agency and website.

Birambye has registered the lodge and its sustainable innovations with United States Green Building Council as the first step to a green building certification. If they achieve the Leadership in Energy and Environmental Design (LEED) certification requested, the lodge might be the first

LEED platinum building in Africa. As the LEED system is more about green construction than sustainable social and economic systems, it may be difficult to reconcile LEED with the broader needs of a developing country. *Birambye's International Rwandan Investment 2008* (Pecoraro, 2008, attached) details the requirements and alternatives for sustainable building site, water efficiency, energy, materials, indoor quality, and innovations. This document also contains photos, maps, a site diagram, and both active and passive sustainable designs. The assessment provides an excellent example of the elements of the green building process. It also presents instructive information about not only what counts for LEED credits, but also about what matters in Rwanda. The lodge will create more energy than it uses, a model project for Rwanda.

All profits from the lodge will go to the L'Esperance Orphanage in Mugonero, Children's Village Kigarama, as part of the plan for a self-sustaining community that has funding for investment in the education, sanitation, and any other needs (L'Esperance, 2008).

Birambye recently built an outdoor kitchen for the orphanage with their thin-shell concrete technique, soon to be thatched on both interior and exterior surfaces.

Thatching reflects the culture of Rwanda and acts as a green roof to cool the building (Pecoraro, 2008). The thin-shell concrete



Photo: *Thin-Shell Concrete Kitchen* at L'Esperance Orphanage, built by local workers and Birambye.

technique uses locally available materials, greatly reducing material mass and transport. Six contractors from Kibuye have received training for this skill, and there are plans for more skill-

based training. It is far less expensive to fabricate this highly durable roof (exceeding U.S. standards) compared to the cost of a typical corrugated sheet metal roof.

Birambye collaborates with other non-profits to identify the needed expertise for L'Esperance and other projects. They have close connections with several chapters of Engineers Without Borders (EWB). EWB-USA will build and install jet stoves at the L'Esperance Orphanage for its kitchens. These stoves reduce the impact on the environment from burning and improve the community's health, as they eliminate over 99% of airborne pollutants (M. Reiner, personal communication, 11/25/08). Manna Energy installed a water purification system at L'Esperance that uses solar-powered ultraviolet light. EWB-USA designed and installed a solar fruit drier prototype and will help with the challenge of processing fruit.

Birambye and the manager of L'Esperance have invited RCW to visit the orphanage near Mugonero to see the outdoor kitchen and other sustainable technology installed at the site (M. Reiner, personal communication, 12/2/2008). It is noteworthy that the President of Birambye worked as co-lead on the infrastructure assessment for The Kigali Conceptual Master Plan (2008). The plan considered environmental, land use, infrastructural, cultural, and socioeconomic factors as well as economic and demographic projections. The Kigali Conceptual Master Plan received the 2008 Daniel Burnham Award for Comprehensive Plan in December 2008, a prestigious national award given by the American Planning Association for innovation and quality in planning (American Planning Association, 2008).

Manna Energy Foundation is a non-profit that provides communities with the technologies "to satisfy their basic human needs, which will ultimately enable them to sustain themselves and thrive with a future independent of outside assistance" (Manna Energy, 2008). Their major work-in-progress is the Rwanda Natural Energy Project. This project will deploy water treatment

plants and biogas reactors to more than 500 secondary schools throughout Rwanda (E. Thomas, personal communication, 12/2/2008). Both systems use established and tested technologies, and support the United Nations Millennium Development Goals by providing clean water, conversion of biological waste into cooking fuel, and elimination of indoor smoke.

The biogas generators take human and kitchen waste and capture the methane. The methane can then become fuel for high efficiency cook stoves. The waste effluent is rich fertilizer, relatively odorless and noninfectious. A benefit of this project was the education and training of students in a technical school in Muramba, who will continue to provide technical support for the systems (Manna Energy, 2008). The Biogas Reactor Project supports Rwanda's Vision 2020 for development through direct investment in a new Rwandan business venture (Ministry of Finance & Economic Planning, 2000). The Kigali Institute of Science and Technology-Center for Innovation and Technology Transfer trains their graduates in the design and business of biogas generators.

Manna Energy and EWB–USA have three solar-powered water treatment plants operating in rural Rwanda, including one at the L'Esperance Orphanage in Mugonero installed in 2007. The water treatment plants provide bacterially decontaminated water for drinking, food preparation and personal hygiene (Engineers Without Borders Video, 2008). The system, also called a Bring Your Own Water (BYOW) Treatment System, is an assembly of proven water treatment technologies. The BYOW system consists of a gravity-fed, inclined tube-settling tank, rapid sand filter, and solar powered electrical ultraviolet irradiation system. The BYOW system treats water collected in containers by local residents at a rate of approximately 10 liters per minute, and can provide up to 8,400 liters of treated water per day. The BYOW system is a

promising technology that addresses the needs of poor, rural, mountainous, and densely populated communities (Gold, Thomas, Byyny, & Habanabakize, n.d.).

Over a period of at least 10 years, the Rwanda Natural Energy Project will train and employ a workforce in Rwanda to install, maintain and operate the systems. This technology directly benefits more than 250,000 students, teachers, and staff in Rwanda. Both the water treatment and biogas systems use materials and technologies that originate in Rwanda and neighboring Kenya, thereby supporting local economic growth and stability (Manna Energy, 2008). The Rwandan enterprise component of the project will create a substantial number of new jobs in Rwanda in order to construct and install the systems (Changemakers, 2008).

Funding for the Rwanda Natural Energy Project is quite innovative, derived from Certified Emission Reductions (CERs) under the United Nations Clean Development Mechanism (UN-CDM). This will be the first CDM project in the world to generate carbon credits carbon credits for the treatment of drinking water (Changemakers, 2008). Training workers helps to assure the proper operation and maintenance of the systems over a minimum 10 year CER crediting period. This economic model depends on a continuing operation rather than initial installation as the source of reward.

These non-profit organizations (Birambye, Manna Energy, GSSA, and EWB) demonstrate a commitment to sustainability for Rwanda through their projects, skills training, and contributions to local self-sufficiency. They introduce tested technology, work with local contractors, residents, and government agencies. Funding for construction and energy projects is through grants, donations, and local businesses that directly benefit communities in need. Local workshops in construction and installation of renewable energy and water systems can help RCW achieve its goals in Bugesera.

To ensure that any building project achieves high performance on environmental and social goals, and stays within budget, an integrated design process is the best approach. Appendix B provides additional details and steps in the Integrated Design Process for RCW's reference.

Amory Lovins, Chief Scientist of The Rocky Mountain Institute and winner of the 2008 award as one of America's Best Leaders (Rocky Mountain Institute, 2008), stated that a green building's connections to its community run deep with links that are environmental, economic, and social. He is a strong proponent of the integrated design process that brings together architects, engineers, artists, builders and others. In the *Foreword to Sustainable Design Guide of the Japan Institute of Architects* (1996), Lovins references the power of the team in sustainable design.

“This team must remain cohesive not only throughout design but also through construction, commissioning, training, and initial operation, to make sure the design intent is fully carried out... To apply technology wisely, in a mature relationship with our needs and capacities; to create architecture as rich as our cultural heritage; to create, above all, designs that celebrate life over sterility, restraint over extravagance, beauty over tawdriness; these truly define the aesthetic and spiritual challenge that calls architects to draw the best from all societies.” (Amory Lovins, 1996, p.4-5)

Conclusion

Little of what happens in Bugesera makes the western news today, but its people have shown remarkable perseverance in the face of tragic misfortune. A model ecotourism project in Bugesera would demonstrate that linking conservation to development can improve the well-being of communities while protecting their natural environment. It is important to first plan for environmental studies and wetland bird surveys. Rwanda and its partner organizations have demonstrated impressive innovations in green technology, renewable energy, clean water systems, and the appropriate use of local materials. These solutions can now be put to work in Bugesera to improve health, grow local enterprises, and support Rwandan self-sufficiency.

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Appendix A

Contacts for Sustainable Building and Energy Projects in Rwanda

Organization	Projects in Rwanda
<p>Birambye International http://www.Birambye.org</p>	<p>Mark Reiner, President reiner@birambye.org</p> <ul style="list-style-type: none"> ▪ Ec lodge, Lake Kivu – 2009 plans: <ul style="list-style-type: none"> ○ Thin-shell concrete: kitchen, lodge, 6 cabins ○ PV powered UV water sanitation ○ Rainwater harvesting ○ Hybrid windmill-solar energy ▪ Rwanda training in thin-shell concrete ▪ L’Esperance Orphanage projects: <ul style="list-style-type: none"> ○ Thin-shelled concrete kitchen ○ PV powered UV water sanitation ○ 60,000 L of rainwater harvesting tanks ○ jet cook stoves ○ solar drying oven project <p>Kat Pecoraro pecoraro@birambye.org</p> <ul style="list-style-type: none"> ▪ LEED Assessment <p>Mark Pitterle</p> <ul style="list-style-type: none"> ▪ Wind Power - Horizontal windmill technologies (designed for on-ground construction and workshops)
<p>Engineers without Borders http://www.ewb-usa.org/</p>	<p>EWB-USA, Boulder, Co. Cathy Leslie, Executive Director cathy.leslie@ewb-usa.org Projects in Rwanda:</p> <p>EWB-JSC www.ewb-jsc.org</p> <ul style="list-style-type: none"> ▪ 10,000 liter rainwater catchment system for hospital <p>EWB-CU and EWB-JSC evan.thomas@mannaenergy.org</p> <ul style="list-style-type: none"> ▪ Solar powered lighting systems for hospital in Mugonero ▪ UV water sanitation system for hospital in Mugonero ▪ Biogas generators ▪ High efficiency cookstoves ▪ Briquetting ▪ Bring Your Own Water (BYOW) Treatment System in L’Esperance Orphanage in Mugonero

Organization	Projects in Rwanda
	<p>EWB-UW, Madison</p> <ul style="list-style-type: none"> ▪ Improve gravity-fed water system in Muramba. <p>EWB-CU</p> <ul style="list-style-type: none"> ▪ Rainwater catchment system in Muramba ▪ Will place jet cookstoves in the kitchens at L’Esperance Orphanage. These burn wood 60% more efficiently and eliminate over 99% of airborne pollutants. evan.thomas@mannaenergy.org
<p>Genocide Survivors Students Association (GSSA)</p>	<p>Didier Sagashya sagashya@birambye.org 08638660 (cell)</p> <p>Deputy Director General of the National Land Centre in Rwanda. Cultural/political assistance. He is Birambye’s liaison with GSSA. Also works with L’Esperance, EWB, and Manna.</p>
<p>KIST - CITT</p> <p>http://www.kist.ac.rw/</p> <p>Kigali Institute of Science and Technology - Center for Innovative Technology Transfer</p>	<p>Academic research institution - they train their graduates in the design and business of biogas generators and other technology.</p> <ul style="list-style-type: none"> ▪ Biogas ▪ Rainwater ▪ Composting toilets ▪ SCEBS ▪ Ram pumps <p>Twagirumukiza Leonard – contact for biogas systems twagiraleonard@yahoo.fr</p>
<p>L’Esperance Orphanage Children’s Center Kigarama</p> <p>www.lesperancerwanda.org</p>	<p>Victor Munroy, Director 0854531 (Kigali)</p>
<p>Manna Energy Foundation</p> <p>http://www.mannaenergy.org/</p>	<p>Evan Thomas evan.thomas@mannaenergy.org</p> <p>Rwanda Natural Energy Project</p> <ul style="list-style-type: none"> ▪ Water Treatment Systems – will install BYOW water treatment system at secondary schools in Rwanda ▪ Biogas Reactor Systems ▪ UN Carbon Credit

Appendix B

Phases of an Integrated Design Process

The integrated design process (IDP) supports sustainable building principles (Whole Building Design Guide, 2008). It is an approach to building design that seeks high performance while staying within budgetary and scheduling constraints. An integrated design allows all systems to work with each other and augment each other. It addresses issues early, avoiding missed opportunities for performance and economy. This design process fully integrates the architectural, mechanical, electrical and other systems of the building to get the highest performance possible.

The result of this design process is a building that functions well and has lower operating and maintenance costs as well as higher value. For example, if the building's form and location lends it toward natural ventilation, a mechanical cooling system can be downsized or even eliminated, as was the case in initial assessment in Bugesera. This process relies on a multidisciplinary and collaborative team whose members make decisions together based on a shared vision and understanding of the project. It follows the design through the entire project life, from pre-design through occupancy and into operation. In summary, the Integrated Design Process is:

- a flexible method, not a formula
- different each time, not pre-determined
- an iterative process with ongoing learning, not a preordained sequence of events
- time and energy invested early
- decisions influenced by broad team

Phase One: Pre-Design

The integrated design process differs from conventional design right from the outset of a project by placing a priority on establishing the goals, core objectives and direction of the project through a visioning session. Pre-design explores the relationships between the project and its surrounding environment to help reveal the optimum choices for the site, the users, and the owner. Sustainability covers a full range of economic, environmental, and social performance criteria. This ambitious beginning requires that many experts be members of the design team at the outset. This phase identifies the program needs, assesses the feasibility and confirms the construction requirements for the project. It includes an initial study of site constraints and impacts, site-related design guidelines, building systems description, a summary schedule and a preliminary budget. The first design charrette occurs during this phase. It is a collaborative planning process that harnesses the talents and energies of all interested parties to create and support a feasible plan that represents transformative community change.

RCW: Host a design charrette and include those involved in the planning, designing, implementing, operating, and using the building (architect, engineers, community representatives, landscape architects, others).

Phase Two: Schematic Design

Schematic Design builds upon the vision developed in Pre-design. It is the phase for thinking “outside the box,” for exploring innovative technologies and fresh application methods in working towards the broad goals and objectives set out in Pre-design. Schematic Design allows experts from all disciplines to analyze the unique opportunities and constraints of the building site. Develop design alternatives based on a synthesis of the entire team’s skills and knowledge. This phase is where an interactive process develops and explores a variety of

alternatives both at the whole building level and at the component level. The primary objective of this critical phase is to develop a clearly defined design including relationships among the project components. Establish the budget and schedule, and apply for permits.

RCW: The team should work to integrate the architectural, micro power, water and other systems of the building to get the highest performance for the lowest cost.

Phase Three: Design Development

Design Development is a time to firm up and validate choices, resulting in a schematic design concept that receives approval by the client. Assess all architectural, mechanical and electrical systems for their expected performance and impact on all other systems as well as on the goals and targets.

Phase Four: Construction Documentation

Prepare the construction documents based on approved Design Development documents as well as final calculations and specifications. If the project is to be successful, maintain the integration from earlier phases during this phase despite the high pressure of deadlines.

Phase Five: Bidding, Construction, Commissioning

It is important to consider many factors to ensure completion of the project goals. Chose qualified contractors, established communication procedures, and transform the abstract into actuality with the expanded team. Pay special attention to the design intent in working through the inevitable construction-phase changes and adjustments. Facilitate the work through effective interface between the disciplines. Start the process of commissioning the building and its systems during construction, testing, and validation. By the end of phase five, the team achieves a finished, fully functional, and well-commissioned building, ready for occupancy.

RCW: Operate the building in accordance with the engineer's design intent. This is called

Commissioning the Building. The best system will not perform unless building operators understand the design and proper operating procedures. It is common to improve efficiency of buildings by 20% - 30% through the commissioning process.

Phase Six: Building Operation

This is a key transition phase during which the design team must ensure that knowledge transfers to the building's new stewards: the owner, occupants, and operations staff. This phase is dependent upon completion and documentation of the commissioning that took place at the end of construction.

RCW: Ensure that there has been an appropriate technology transfer and that skill building, training of local workers is on track.

Phase Seven: Post-Occupancy

Integrated design does not end when construction is complete and occupants have moved in. The IDP seeks to enhance the entire life of the building through effective maintenance and operation, measurement and verification, re-commissioning, and building performance evaluation. The post construction portions of the process provide feedback loops, which facilitate continuous optimization of the building's performance. In addition, lessons learned from this feedback can trigger small-scale improvements in operation that can bring significant benefits to the occupants and owners alike. Lessons learned can also inform future projects.

RCW: Issue a sustainability report every two years to reassess the overall impact of an eco lodge. RCW could create a press release with the results, and share it with the sustainable development field.
