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A Sustainable Kitchen

Hyeon-Gyeong Yun

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Rochester Institute of Technology

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A Sustainable Kitchen

by
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July 31, 1997
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Date 6. 7 97
I am grateful to all of those who were helpful during the process of working on this thesis: to Charles Lewis, Nancy Chwiecko and Paul Gardner for their continued guidance and contributions; to Sun-Ock Moon for support with the care of my little daughter and; to my husband for generosity and encouragement.

You all have been most helpful.
To my parents and parents-in-law
Thank you for everything.
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The aim of this project is to bring the most important issues of environmentally conscious designs into the kitchen. Through this project, I created a sustainable kitchen by researching much of today’s information which may change tomorrow. Because environmental research and design is a continuously developing area, my sustainable kitchen will be one example of many possible and functional designs.

Near the end of my first graduate year in interior design at Rochester Institute of Technology (RIT), I discovered a new term “sustainable design”. The term “sustainable design” instantly provoked my curiosity, not only to the emerging field, but also the very influential discipline of the present day, and moved me to research it, and its relationship to the concept of sustainability.

**Concept of Sustainability**

Sustainability is a broad and ambiguous term. With the current mainstreaming of environmentalism, sustainability and sustainable design becoming hot discussion topics, there is little agreement about the exact definition of these terms.

The word sustainability has become a popular catchphrase of the nineties. The environmental crisis and movement has brought this concept to the forefront of environmental policy in this decade. However, due to the youth of this concept, sustainability has many definitions and meanings, depending on one’s perspective. Economists understand sustainability as a tool for the survival of modern man’s luxurious living. On the other hand, sustainability to some biologists would be a holistic view of the earth as an eco-system with humans as only a part of that system. Regardless of the different perspectives, all advocates of sustainability have one common general goal; the capability of mankind to maintain itself over time.
The concept of sustainable design has been worded in many different ways: “green” architecture, environmentally-sensitive design, ecological design, design with nature. Regardless of what it is called, sustainability, from a design perspective, involves the design of built environments which exist in a symbiotic relationship with both the environment around the design and the environments from which the design materials originated.

Sustainable design is an ecologically based philosophy which means that the design principles must be all-encompassing, considerate of the whole eco-system. The “green” architect or planner must be concerned with not only the buildings that of the environment, the resources, the local culture and economy, the materials, and the environment which the materials originated from. (Hsin 1996)

Sustainable design is not a new “style” of architecture, like Modernism or Brutalism, rather it is a method of design thinking. It is a design methodology based on ecological principles and ideology which embraces the natural processes of the earth.

A New Notion of “Waste”

At the close of the twentieth century, the world’s garbage dumps are filling up with the toxic artifacts of our industrial culture, while the earth’s atmosphere, water reserves, and other resources have been severely damaged and depleted. The kitchen, as well as the bathroom, is a major site for water waste in the typical home as well as the bathroom. Unlike the conventional kitchen where the kitchen supported a rhythmic cycle of ingestion and waste: a process of elimination, a new notion of waste is beginning to take shape: an ethos which values recycling and re-use over the stock piling of discarded merchandise.

The kitchen is a site not only for water conservation but also for managing consumer waste in general. The placement of garbage cans was not seriously considered during the
evolution of the kitchen in the past; period views rarely show the can at all, which is assumed to be snugly beneath the kitchen sink. Some designers and publishers have identified trash as the focus of the next design revolution:

In the past hundred years, social and technological changes have transformed kitchen design. Our absolute need to look at garbage differently will bring about the next sweeping change. Look for built-in composters and rented cabinets, chutes that carry used materials to storage bins in the cellar or yard, base cabinets that are actually rolling bins. (Poore 1989)

William Stumpf, a designer who pioneered more practical recycling at home, suggests that the human body is a model for domestic consumption: our houses “should have a digestive system just like we do.” (Brown 1989) The kitchen in Stumpf’s Metabolic House is a highly articulated garbage center, with chutes for sorting recyclable and mulchable trash; paper is burned to heat the building. David Goldbeck has also challenged the conventional modern kitchen by incorporating principles of recycling, composting, and resource conservation in his design.

Kitchen and Sustainability

Kitchens are becoming productive in ways beyond just food preparation by incorporating space for recycling, composting and in-door gardens. This design, this user and planet-friendly kitchen includes convenient, specialized areas: for collecting and sorting recyclables and for collecting compost for transfer to the greenhouse.

The greenhouse uses filtered, recovered kitchen water and compost, recycled food scraps, to produce year-round home-grown, organic produce, while also adding needed humidity in the dry winter months. Many green leaf plants will absorb and filter-out harmful indoor-air pollutants, such as formaldehyde and carbon monoxide.
The sustainable kitchen and greenhouse function holistically, integrating the needs of the family with the strengths of mother nature, for the benefit of both. Although sophisticated and complete in function, the design of the kitchen is simple and natural, answering the simple question: what are the inherent strengths of nature? Sun, water, earth and air can be integrated into most designs by both respecting and incorporating these naturally occurring elements.
This environment-friendly kitchen is designed to fit the lifestyle of a two-cook family with incorporated requirements and features, like low or non-toxic materials, energy-efficient appliances, good indoor air quality, recycling, noise control, and conservation of resources in everything from kitchen cabinet design to water consumption.

**Orientation and Site Establishment**

Before designing the sustainable kitchen, I established the solar orientation of the kitchen. Because sunlight supports the usage of solar energy, energy efficiency correlated to insulation, and natural lighting, the kitchen was sited with a south and east orientation. To accomplish another environmental-friendly kitchen design criteria, it is located adjacent to a greenhouse, which needs south-light as well, for composting of waste and producing organic vegetables and fruits.

**Needs Analysis**

I determined that the kitchen should have multiple sinks for different preparations, such as meat and vegetable, or for two cooks, and that each required adequate light. A kitchen desk or workstation to plan menus, to prepare schedules and to pay bills is also an important element for a modern kitchen. I also propose an informal dining space to provide a comfortable atmosphere among family members or friends. I designed open shelves and storage for display and easy access. Standard counter depth is 25 inches but I made 30 inch deep counters which is an effective way to minimize the need or use of overhead cabinets and to place smaller but frequently usable amenities. All these features are some of the important elements of my kitchen design.
In order to plan the environmentally conscious kitchen, I proceeded to analyze common kitchen design criteria and the issues that define it. According to “The Smart Kitchen” by David Goldbeck, the primary factors of a kitchen can be categorized into three perspectives which are human comfort/safety, appliances/energy efficiency, and air, water quality/waste disposal/food production. The following diagram shows these aspects in detail.

![The Primary Elements of a Residential Kitchen](Fig. 1)
The modern residential kitchen is frequently designed in response to the Work-Triangle. This triangle is identified by circulation between the three primary appliances or work centers. These are the main cooking center, the sink/clean-up center, and the storage/refrigeration center. Each work center has its own featured appliances in varied style and function.

![Diagram of Kitchen Appliances]

**Fig. 2**
To list some of the features of a sustainable kitchen, I have included a general checklist for environmentally sustainable design.

Elements of Sustainable Design

Following, are more specific lists of the important features of an environment-friendly, sustainable kitchen.
Important Features of an Environment-friendly, sustainable Kitchen

- passive and active solar energy
- east and south facing windows for natural daylighting
- greenhouse for growing own vegetables
- use of insulated, solar oriented windows
- multiple refrigerator and freezer components due to their varied function and needs
- recycling, re-use, and composting centers with trash compaction
- energy efficient appliances and lighting
- use of non-toxic or low-toxic paint and finishes
- energy-efficient radiant floor system: hot water tubing under flooring
- use of recycled and resource efficient materials
- use of non-toxic materials and products
- water conservation
- xeriscaping; low water landscaping (Gardner 1997)
Initially, the most challenging and important part of this project was becoming able to alter my preconceptions related to the conventional kitchen. To break those stereotyped images of kitchens, I chose “brainstorming”; listing scattered ideas that were obtained and collated during the research.

Next I began to define relationships of the kitchen, the greenhouse, the dining room, the living room, and the outdoors. Solar energy requirements dictated that the kitchen and the greenhouse be placed to face south and east. The bubble diagram below indicates the interrelationship of the remaining spaces.
In initial planning, I divided the kitchen into two major areas which are the main work center and the desk, both with some important elements of sustainability. Below the desk, which is for paying bills and planning meals, is a recycling drawer to manage the office paper waste. The main work center has several features related to sustainability, such as a compost system, recycling bins, trash compactor, re-use storage, and movable cabinets. (Fig. 9) The recycling bins and compost storage are so isolated because their function is more closely attached to the work center. For example, the fact that composting and recycling of glass/cans is most done directly from the sink, helped shape the following diagram. Also, the compost storage is located in the greenhouse where composted soil is used to grow vegetables.

**Bubble Diagram 2**

![Bubble Diagram 2](image)
An exciting feature of this kitchen is that waste water from the kitchen appliances, like the dishwasher and the kitchen sink, is plumbed into the greenhouse, run through a special filter and used for irrigation. Inside the greenhouse, the floor is concrete, made locally with recovered incinerator ash. Recycled rubber (auto tire) floor material is used in the mudroom. The compost storage area under the main sink is provided for conveniently carrying of compost from the kitchen to the greenhouse. An exterior door under the sink is connected by walkway to the greenhouse door. (Fig. 6)

An ultrasonic dishwasher (Fig. 8) is proposed to conserve water, and an experimental “Omnicooker” (Fig. 9) would conserve energy used in many cooking processes.
Multiple sinks and refrigerators provide access for two cooks and separation of many preparation and clean-up tasks. The dual work triangles permit two cooks to work simultaneously. (Fig. 8)

Elevations

Solid maple, salvaged from a demolished building, is mainly used for the flooring, with low-toxic carpeting made from recycled plastic containers, installed in the living room. Moreover, a radiant heating system, which is built into a building element such as a ceiling, wall, or floor, is adapted to produce a net heating or cooling effect on the room by the means of the circulation of hot or cold water through the tubing.

Recycled deck material made from recycled PET#2 (milk jugs) was used for the entrance and rear porch. Recycled drywall with wood molding from a salvaged source was applied throughout the house.

A south-facing roof provides the solar-heated water through solar collectors. The solar-heated water provides the base of hot tap water as well as circulates through the radiant tubing in the floor of the house.

While one half (glass) of the roof is dedicated to generating hot water, the other half (solid) is covered by photovoltaic panels for generating electricity. R-8 solar glass, one of the highest R-values in the industry today, is used for the windows.
**Implementation**

**Kitchen Floor Plan**

Fig. 8

- Multiple Sink
- Recycling Chutes
- Ultrasonic Dishwasher
- Solid Surface Countertop
- Cooktop
- South-Facing Natural Daylighting
- Omnicooker
- Open Shelves

**Kitchen Section**

Fig. 9

- Undercounter Natural Cooler
- Composting System
- Recycling Bins
- Re-use Storage
- Wine Cooler
- Trash Compactor
- Recycling Storage
- Freezer & Refrigerator
- Refrigerator Drawer
- Pantry
Composting Garbage Disposal System

The composting garbage disposal system chops kitchen scraps into a material that composts almost instantly and, instead of sending chopped material to a septic system or municipal sewers, diverts it to a removable container. According to Seventh Generation, a catalog of sustainable products, this system not only reduces septic and sewer waste and treatment, but also allows you to use the final material as compost directly.

According to David Goldbeck, in *The Smart Kitchen*, recycling chutes, one for cans and another for glass and plastic, drop into separate bins, easily accessed from outdoors. On recycling day, one can simply open the outside access doors, and the bags can be removed to a municipal recycling facility. (Goldbeck 1989)

Recycling space for paper, metal, and plastics is placed between the main sink and the re-
use storage. Re-use storage contains re-usable jars, plastic containers, and bottles. In addition, a solid surface countertop was chosen because it is durable, long lasting highly heat resistant, non-porous stain resistant, easily cleaned and maintained, and a low-toxic work surface. Long lasting materials support sustainability because they will not be frequently disposed of.

The ultrasonic dishwasher (Fig. 11):

fills with water, vibrates food from the dishes, then passes the water through recycling loops where a filter provides high-speed removal and water cleaning for re-use of contents. (Pope 1993)

This special dishwasher saves water with its own water-purifying system that cleans and recycles water rapidly, using only two gallons of water per week. In addition, its countertop location prevents back-straining.

**Ultrasonic Dishwasher and Omnicooker**

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**Fig. 11**

**Fig. 12**
Instead of using both a conventional oven and a microwave oven, I chose to use an innovative cooktop omnicooker (Fig. 12) which utilizes heat conduction, heat transfer by moving gas, and radiation like a microwave oven. This omnicooker is a doorless oven with special covered glass casserole dish and provides faster, more efficient cooking, retaining more nutrients. Also, it takes up a small countertop area.

To reduce the noise level of existing range hoods and refrigerators, NCS (Noise Control System) was applied.

This system not only reduces the unwanted noise through the emission of anti-noise which produces an equal but opposite soundwave, but also uses less energy to operate. (Leborics and Miller 1992)

**Kitchen Cabinets, Open Shelves, and Natural Daylighting**

Kitchen cabinets that minimize environmental impact were also an important part of the design. These kitchen cabinets can be made either from recycled or salvaged wood, or
Implementation

wood from a certified, sustainable source, all are formaldehyde-free. Most of the kitchen cabinets are removable and re-usable when the homeowners need to move or change.

Mid-temperature wine storage and refrigeration for vegetables, fruit and beverages are placed under the counter for handy serving and preparing. (Fig.9) The refrigerator can be opened from both the kitchen and the dining room. A high efficiency, low temperature general refrigerator and freezer are located next to the storage cabinet and near the second sink, also supported by a refrigerated drawer under the counter. Basically, the refrigerators, used in this project are modular units, placed near the appropriate work centers.

The use of compact fluorescent lamps and full-color spectrum fluorescent fixtures (recommended for individuals suffering from seasonal affective disorder) reduces the electricity bills. These are four times as energy-efficient and last an average of ten times longer than standard incandescent bulbs.

For the walls and the ceiling, low-toxic interior finishes are used to provide healthier indoor air quality. These low-toxic finishes contain no heavy metals and emit very low levels of VOCs (Volatile Organic Compounds), which have been identified as a significant contributor to the formation of ground-level ozone, a major component of "smog".
The conventional kitchen contributes much to the waste stream and ignores many sustainable design and function opportunities. Using several general design criteria: energy efficiency, low-toxic and resource efficient materials and products, waste re-use and recovery, and food production, a kitchen can be transformed from a waster to a producer.

An efficient kitchen is a productive kitchen. Blending common kitchen features, with their design for convenience, with sustainable, long-range thinking, the kitchen can contribute maintenance and future strengthening of the environment. This kitchen is an example; a prototype of a sustainable, productive kitchen. As technologies change and improve, and as the environmental market expands, encouraging a greater support industry, more and more design features, products and professionals will appear. One day, our non-conventional, sustainable concept of kitchens may be the convention.

As designers, we should constantly and continually push our industry and ourselves to explore and expand in sustainable, ethical (naturally similar), and productive designs. Functional designs offer both form and function. This is the art of design; the blending of self-expression with ethical solutions.

Together, as an industry and culture, we can wait for tomorrow or lead the way. As our kitchens can ultimately produce worthwhile results so can we as designers.

Gardner, Paul. Personal Interview by Author, 18 July 1997, Rochester


