August 24, 2006

New Village Institute
159 D Calle Ojo Feliz
Santa Fe, NM 87505

To Whom It May Concern:

We have completed the energy calculations for an Oshara home. In summary, we found that an Oshara home incorporating the specified energy-saving features in the building envelope, as well as energy-efficient lights and appliances, will use an amount of energy corresponding to the energy content approximately 824 gallons of gasoline annually. By contrast, an energy code-compliant new home built in Santa Fe using standard construction practices, equipment, lights, and appliances will consume approximately 1,708 gallons of gasoline each year. **This represents a projected fifty-two percent reduction in energy use over typical construction techniques.**

We note, however, two significant benefits that do not show up in the energy calculations are the use of a modern, high-efficiency wood burning stove and a photovoltaic electricity system. The use of such devices shifts energy use from investor-owned utility-supplied natural gas or electricity to local renewable sources such as biomass (wood) and the Sun. This contributes greatly to supporting local residents and businesses by keeping money spent on energy within Santa Fe. We would also point out that the differences in energy use will mean greater and greater annual savings as natural gas and electricity prices continue to climb.

A detailed discussion of the assumptions used to calculate these figures follows this summary page. I have also attached the supporting documentation referenced in the discussion.

Please let me know if you have questions or comments about this report. I can be reached at 505-982-9800 or via e-mail at frank@localenergy.org. We appreciate this opportunity to begin building a relationship with you and look forward to working with you in the future.

Sincerely,

Frank Currie, PE

Attachments:
Typical SF House Building File.pdf
Oshara House Building File.pdf
Energy Performance Summary.pdf
Energy Performance Summary –Slab Insulation.pdf

## DISCUSSION

### *Summary*

Local Energy was asked by New Village Institute to model the energy use of one typical home in Oshara Village according to construction assumptions provided by New Village Institute. The goal was to estimate annual energy use for an Oshara home incorporating energy-efficient features in the building envelope, HVAC systems, and lights and appliances. The home was also to incorporate a solar thermal system to heat domestic hot water and a modern, highly efficient catalytic wood burning stove. The energy use was to be compared to a house with an identical footprint, but that is built using standard local building practices to just meet state building and energy codes. Finally, energy use numbers were to be presented as *equivalent gallons of gasoline*. The two building files detailing the assumptions used in the model are attached.

### *Assumptions*

A residential energy modeling program called REM/Design was used to calculate energy consumption for the following three scenarios:

1. Scenario 1 is a base case representing standard local residential construction practices intended to just comply with state residential building and energy codes – this is basically a 2,000 square foot house with 2x6 exterior walls insulated with fiberglass batts, a forced-air central HVAC system, and no regard for passive solar orientation.
2. Scenario 2 is a case representing a potential Oshara home utilizing passive solar techniques. It is essentially the Scenario 1 model with 2x8 exterior walls insulated with blown-in cellulose, passive solar orientation, an efficient boiler-fired in-floor radiant heating system, passive cooling (no air conditioning), low-emissivity windows, solar thermal domestic hot water heating, ENERGY STAR-rated lights and appliances, and a modern high-efficiency catalytic wood-burning stove.[1] We also assumed a slightly better air infiltration performance for the Oshara house since blown-in cellulose has been proven to decrease unwanted air leakage over batt-insulated walls.
3. Scenario 3 is simply Scenario 2 with insulation added under the radiant slab to determine the energy savings associated with under-slab insulation.

The energy costs used represent current PNM gas and electricity charges, including the natural gas service charge increase PNM recently requested. We used ~8 cents per kilowatt-hour plus monthly service charges for electricity and ~97 cents per therm plus monthly service charges. We did not put a heavy emphasis on costs since the intent of the study was to compare relative energy use. We include this discussion of energy costs only because annual cost estimates are part of the energy performance summary report (attached). Of course the advantages of building and living sustainably will become more obvious as energy prices rise.

### *Results*

*Scenario 1 and 2 Results Comparison*

The attached "Energy Performance Summary.pdf" shows the energy use estimated for Scenarios 1 and two. Table 1 below also shows these energy estimates, but it also accounts for the fact that electricity used in a home does not represent the primary energy that went into producing that

[1] It is important to understand that the overall energy efficiency of any combustion device is less than the advertised (theoretical) efficiency. This is especially true when combustion devices like wood burning stoves draw combustion air from inside the conditioned living space since that combustion air is being replaced with cold outside air infiltrating through any gaps and cracks in the building envelope. While the wood in the stove may be being burned at a high efficiency, the net effect is *much* lower. The best way to keep a device operating as efficiently as possible is to bring in combustion air directly from outside. Piping combustion air from outside also eliminates a number of potential health and safety issues.

electricity. To explain, electricity is produced by electric generating stations which are typically located far from the point of the actual use of that electricity. To properly account for the true energy that went into a kilowatt-hour used in a home, the efficiency of generators and transmission & distribution lines must be included. This is in contrast to natural gas being delivered to one's house since natural gas is the actual primary fuel being burned, so that taking equipment efficiency into account is enough. Typical electrical generation, transmission, and distribution efficiencies on the order of 30-35%, depending on the generator. This estimate includes the combined efficiencies of all equipment outside the walls of a house. We used an overall efficiency of 31% based on U.S. Energy Information Administration (EIA) estimates.

Table 1. Comparison of Projected Energy Use in Oshara and Typical Santa Fe Construction

| | Typical New Santa Fe Home | | | Oshara Home w/Energy Features | | | |
|---|---|---|---|---|---|---|---|
| Component | Load MMBtu/yr | Consumption MMBtu/yr | Gasoline Equivalent Gallons | Load MMBtu/yr | Consumption MMBtu/yr | Gasoline Equivalent Gallons | Reduction (%) |
| **Heating** | 84.1 | 84.1 | 678 | 50.3 | 50.3 | 406 | 40% |
| **Cooling** | 5.6 | 18.1 | 146 | 0.0 | 0.0 | 0 | 100% |
| **Domestic Hot Water** | 22.8 | 22.8 | 184 | 4.5 | 4.5 | 36 | 80% |
| **Lights & Appliances** | 26.9 | 86.8 | 700 | 22.9 | 47.4 | 382 | 45% |
| **Total** | **139.4** | **211.7** | **1,708** | **77.7** | **102.2** | **824** | **52%** |

Once the electricity use in table 1 was "reflected" out to the primary energy source as just discussed,[2] we converted the energy estimates to gasoline equivalent gallons using the assumption that one gallon of gasoline contains 124,000 Btu of energy (source: EIA).

In conclusion, our study suggests that a typical household can reduce energy consumption by up to the equivalent of 884 gallons of gasoline each year by incorporating the energy features offered by Oshara. This energy savings is in addition to any actual gasoline use reductions a family might enjoy by utilizing other advertised aspects of Oshara Village.

*Under-Slab Insulation*

We found that the addition of R-5 insulation under the radiant slab (Scenario 3) reduced energy consumption by 29 equivalent gallons of gasoline annually. This translated to approximately a $35/year reduction in heating energy costs. The energy performance summary for this scenario is in the attached "Energy Performance Summary - Slab Insulation.pdf."

[2] In the case of PV, only the portion of electricity use supplied by the utility is reflected out through the transmission system. The inefficiencies of PV-produced electricity are inherently included in REM's energy calculations.