

Proposal To:

LIPA

***CLEAN ENERGY INITIATIVE
R&D OPTIONS***



*Eliminating Long Island's
Leaking Oil Tank Problem
&
Saving Residential Energy
By
Converting
To
Combined Space & Water Heating
Using
Tankless Gas or Tankless Electric
Water Heaters*

Submitted By:

WaterFilm Energy, Inc.

Medford, NY 11763

631-758-6271 [Fax: 0438]

<http://oikos.com/gfx>

E-Mail: gfx-ch@msn.com

Louis DeBrino
Manager
Electric Marketing/Conservation
LIPA
1393 Veterans Memorial Hwy.
Hauppauge, NY 11788
516-382-2037 [Fax: 2112]

2/22/99 Modified 3/02
Proposal For

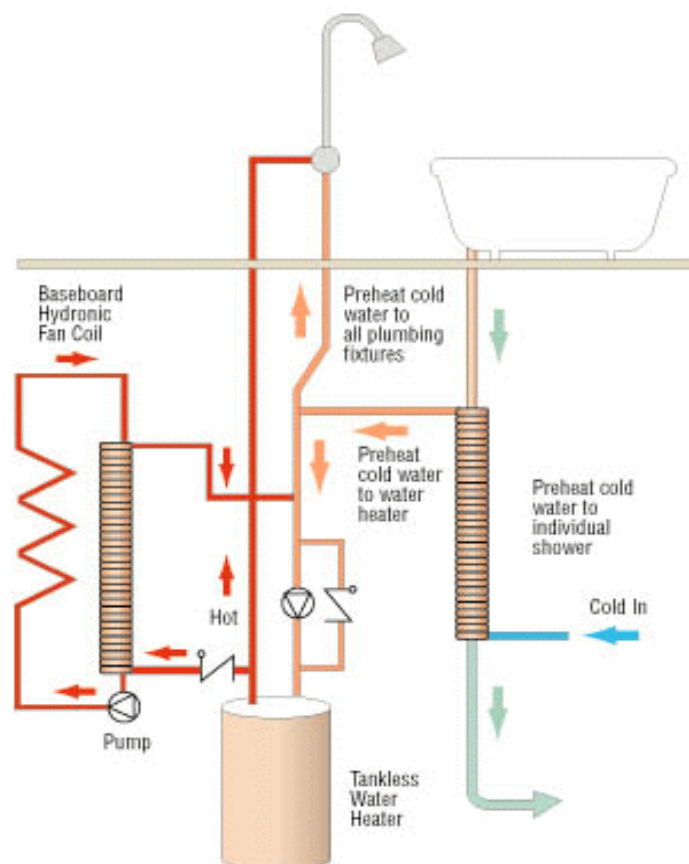
LIPA's Clean Energy Initiative R&D Options
"Eliminating Long Island's Leaking Oil Tank Problem & Saving Residential Energy By Converting To Combined Space & Water Heating Using Tankless Gas or Tankless Electric Water Heaters"

Dear Mr. DeBrino:

The illustration below is of a novel combined space & water heating system called GFX-CH. It has been operating in my house in Patchogue since 1995. Tables A to F summarize its performance.

GFX-CH would fit into LIPA's Clean Energy Initiative, R & D Options for several reasons:

1. There are many benefits to using water heaters for space and water heating. [See Appendix A, "Using Water Heaters for Radiant Heat", by Bill Clinton, as printed from the WebSite for The Journal of Light Construction @ www.jlconline.com/jlc/archive/energy/water_heater_heat/index.html];
2. The figures below illustrate that GFX-CH is much safer & simpler than both boiler systems and the combination systems described by Mr. Clinton;
3. Modern tankless gas water heaters are very efficient, offer low emissions & negligible standby loss;
4. This will lead to a dramatic reduction in site energy usage & pollution if aged oil burners are replaced;
5. GFX-CH can use either tankless-gas or tankless-electric water heaters if gas is not available;
6. Use of tankless electric water heaters will provide close to 100% site-efficiency, eliminate all point-of-use air & ground pollution & the high cleanup costs associated with leaking subterranean oil tanks;
7. GFX can cut a water heater's shower load by recycling power so that a 10 to 15 kW [44 to 63 A @



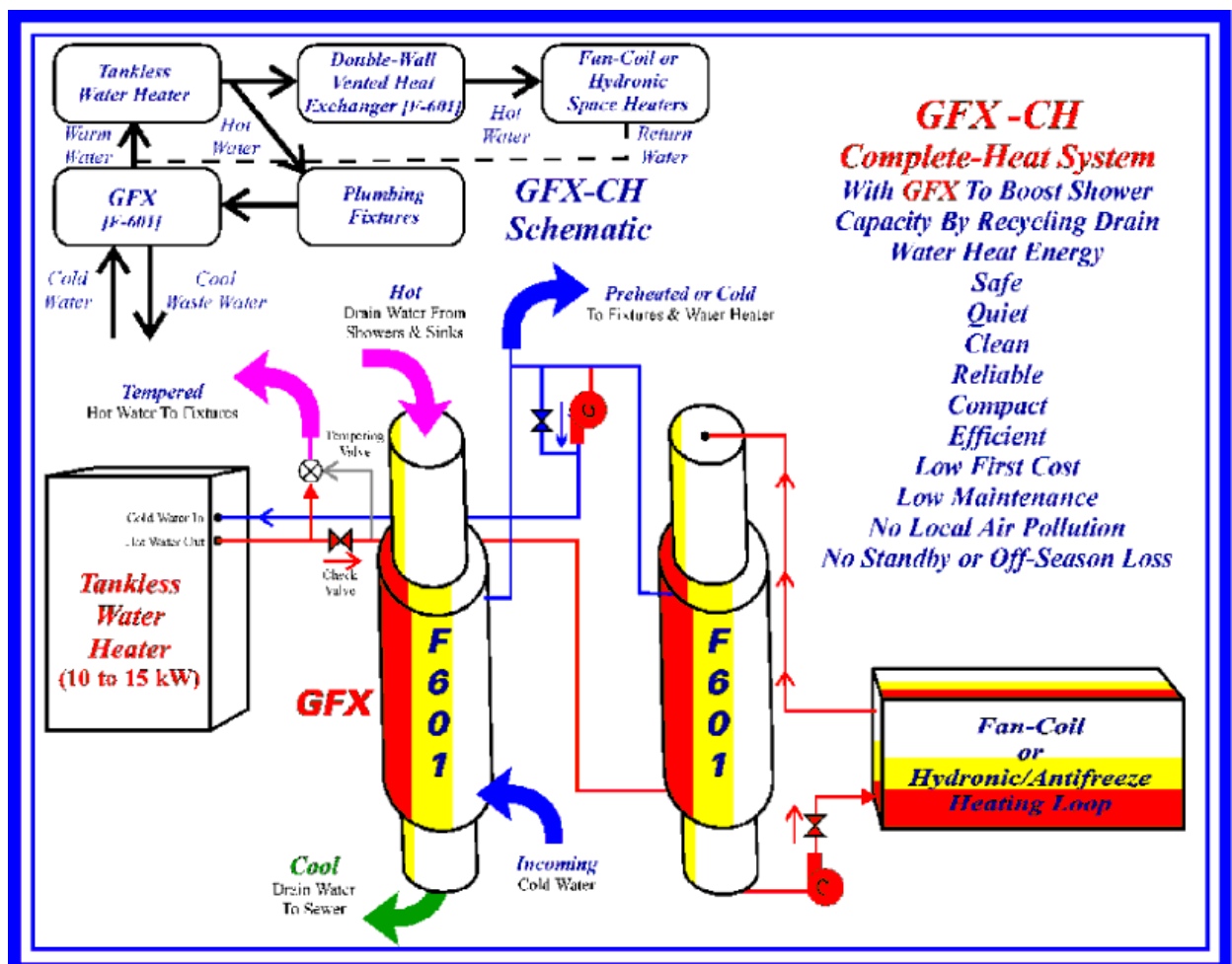
8. 240V] instant water heater can provide both space and water heating for many Long Island homes [See PP&L data below];
9. This cuts I²R losses which are born by utilities;
10. As illustrated below, GFX-CH is compatible with off-peak storage;
11. Existing oil tanks, insulated then filled with antifreeze could provide a cost effective way to increase LIPA's revenue and solve Long Island's leaking oil tank problems.

Long Island's Leaking Oil Tanks

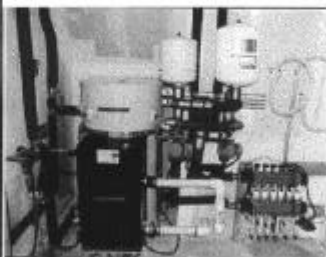
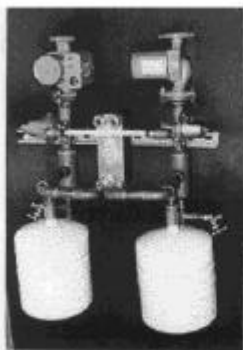
A recent Newsday article discussed problems associated with leaking oil tanks and indicated 44,000 have been located to date. There are probably thousands more in KeySpan's marketplace.

Newsday also published horror stories about oil from leaking subterranean tanks seeping into neighboring basements. The cleanup cost exceeded the Homeowner Policy limit. Litigation costs are mounting.

All this could have been avoided by converting to GFX-CH using either gas or electric. For the latter, off-peak storage, perhaps using existing oil tanks filled with antifreeze, would be ideal, as illustrated below:



**Comparison Between Conventional Complete-Heat System Using
A Gas Storage Water Heater & External Heat Exchanger
With GFX-CH Using Falling-Film Heat Exchangers**



SuperStor's Voyager water heater works well in dual-purpose applications, for both drinking water and space heating. Voyager offers a built-in heat exchanger, but the author prefers to use an external unit, shown preassembled with expansion tanks and circulators in the photo (above left). The heat exchanger is fully insulated and is located between the tank and the red and blue heating loop manifold (above right).



10 Gallon
Clear Meter

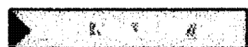
GFX
(F-401)

F-001

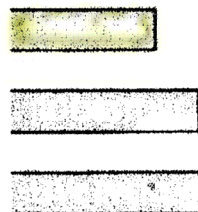


GFX Resistor F-001 to
(With Pump) Hydraulic Loop

**GFX-CH
Prototype
(Slab Construction,
Patchogue, NY)**



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Heat Exchanger Systems

Heat exchangers keep the potentially stagnant heating water completely separate from the domestic water system. In a heat-exchanged system, the space heating side is set up almost exactly as it would be if you were using a conventional boiler as the heat source (Figure 4).

Dual-Purpose System With Heat Exchanger

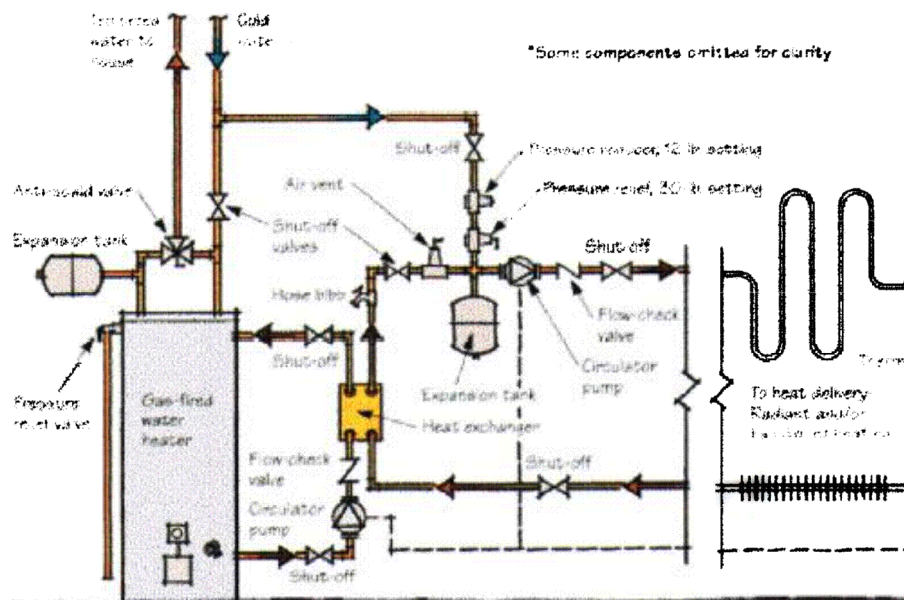


Figure 4. The author's favorite system uses an external heat exchanger to isolate the heating loop from the home's drinking water. The tank temperature is set high enough to meet the heating demand, while the domestic water is tempered for safety.

The hot water in the tank warms the metal in the heat exchanger, which in turn warms the water in the heating zones.

There are two types of exchangers, the external-mount flat plate style and the internal double-wall coil (Figure 5).

GFX-CH
Is
Simpler
&
Safer
With a
Double
Wall
Vented
Heat
Exchanger

This is another area where an R & D effort will be required to devise a cost-effective method to insulate existing subterranean oil tanks through their filler tube.

EPA funding for this may be available for this R & D Option.

Other Benefits of GFX-CH

Unlike resistance electric heat, which use snap action thermostats, the Acutemp instant water heater used in the GFX-CH prototype has a proportional control. This keeps I²R losses to a minimum because the circulators simply run longer on colder days. Peak water heater current flows during short warmup period.

An automatic priority is given to any domestic hot water demand.

With the GFX-CH prototype set for 10kW or 15 kW, after a short warmup period at full power, the water heater current settled back to hover near 35 Amps; as determined by the heat transfer of the convectors.

This is another area where an R & D effort would be needed to quantify the benefit to LIPA of providing a controller to slew the hot water set-point so as to keep the circulators running continuously.

The net result would be a unity power factor load for LIPA, with a predictable relationship to temperature & wind-chill, AND steady, even heat for its customers. [*I do this manually, when I remember.*]

Some instant gas water heaters also permit a variable set-point; a feature that will provide added energy savings as compared to standard oil and gas systems which are often over-powered, with a fixed firing rate that is too high for even the coldest day. This causes frequent cycling and lots of stack losses & emissions.

GFX's Energy Savings

GFX saves energy by recycling drain water heat. The following Table was obtained from recent measurements taken by PP & L, Inc. on their Winter Relief Assistance Program [WRAP].

***PP&L, INC. WRAP/KEEP WARM
GFX STUDY****

Account #	No. of Daily Showers in Household	Pre-GFX kWh/Day for Water Heating	No. of Days Monitored	Post-GFX kWh/Day for Water Heating	No. of Days Monitored	Estimated Annual Water Heating Savings @ 8.5¢ per kWh	Estimated Payback Based on GFX Installation Price of \$500	Percentage of Overall Water Heating Savings
630-6331-350	5	18.56	71	15.15	166	\$104.04	4.8	18%
637-1454-000	3	10.00	84	10.15**	105	*****	*****	*****
624-2437-950	5	17.76	92	11.60	176	\$168.50	2.65	34.7%
623-3615-600	2	8.6	64	6.45	221	\$ 65.79	7.6	25%
624-4780-250	4.5	27.06	64	22.09	251	\$152.00	3.3	18.4%
631-0328-800	8	19.82	75	13.17	29	\$199.50	2.5	33.6%

* PP&L's Winter Relief Assistance Program [WRAP] Manager is Linda Melenchek [610-774-3214].

** GFX's coil was never connected after being mounted in drain line.

Additional energy savings are realized by converting older oil systems that send heated inside air up chimneys with their stack emissions. In fact, the GFX-CH prototype led to huge site-energy savings because the air vents in the utility room housing the oil burner could be closed and insulated. This led to large drop in standby loss and heat loss through the bathroom wall and contributed to an annual site-energy savings of 50 to 60 million Btu. [See Table F]

This qualifies GFX-CH as a candidate for LIPA's Clean Energy Initiative, since LIPA's power plants burn cleaner than aged residential oil burners. Site-savings of 50 to 60 million Btu/yr and a unity power-factor load will offset transmission line losses and help appease both utility load managers and foes of old-fashioned electric resistance heat, which exhibits a poor power factor caused by frequent switching of high currents.

Leasing With Shared Savings

The low cost and compact size of both GFX and GFX-CH make them attractive candidates for leasing by LIPA. The GFX-CH prototype shown above will fit into the corner of the utility room.

Maintenance costs will be low because of the lack of complexity afforded by using an unpressurized hydronic loop as compared to any of the systems described in Appendix A. All copper construction ensures long life and a high scrap-value after 30 years.

Water heater leasing programs have been profitable for utilities in the U.S. and Canada. GFX's manufacturer, Vaughn Manufacturing Corporation, specializes in supplying efficient, long-life stone-lined water heaters for custom utility water heater leasing programs. Information on these programs can be obtained via the Vaughn web site <http://www.vaughncorp.com>.

If we discount the highest and lowest savings measured on PP&L's WRAP/KEEP WARM programs, the average savings for GFX is about \$140/year @ 8.5¢/kWh. This would rise to about \$230 at a LIPA rate of 14¢/kWh.

For gas water heating @ 75¢/THERM & 75% conversion efficiency, the value of GFX's savings drops to around \$55/yr.

To promote energy conservation, LIPA could afford to lease GFX for \$5/month to preserve revenue from its gas customers, while providing larger savings to electric water heater customers and tripling their shower-capacity.

Safety & Liability

1. Unlike the double-wall, unvented heat exchangers discussed by Mr. Clinton, [Appendix A, pg. 3-2] the high heat transfer coefficient [~ 440 Btu/sq.-ft per deg-F] of the falling-film heat exchanger used in the GFX-CH prototype resulted in an approach of 11.4°F with a 30°F drop in the heating loop;
2. To duplicate the performance of the existing oil system with an outside temperature was 28°F @ 36 Amps, an Acutemp set-point of 170.4°F delivered 159°F water to the baseboard convectors;
3. The return water temperatures were 129°F and 140.5°F, respectively, from the convectors and from the falling-film heat exchanger coil feeding the water heater;
4. Double wall vented construction eliminates cross-contamination and permits antifreeze to be used in the hydronic loops without fear of potable-water contamination --- a safety feature absent from the Combi-Cor design; [See Appendix A, pp. 3-1,-2]
5. Therefore, copper convectors will never experience corrosion, nor will there be any liability due to freezing during power outages;
6. With antifreeze, aluminum tubing could also be used to cut baseboard convector costs;

7. Unpressurized operation of the hydronic loops promotes safety and eliminates the need for relief valves; [See Appendix A, pg. 3-1]
8. There is no flow-dependent pressure drop on the unpressurized falling-film side of the heat exchanger, so multiple zones can be fed by simply adding loops & circulators;
9. Modern tankless water heaters offer better safety and reliability than boilers or storage water heaters.

Conclusion

Please consider GFX & GFX-CH, with or without off-peak electric water heating as an R & D Option, for LIPA's Clean Energy Initiative. Very little R & D will be required with instant gas water heaters because all components are commercially available and could easily be packaged into a universal subsystem capable of using any type of instant water heater --- natural gas, electric, propane, oil, solar, etc.

Dated: February 22, 1999
Patchogue, NY

Dr. Carmine F. Vasile,
Ph.D. Electrophysics

GFX-CH PERFORMANCE

Site Energy Usage & Costs

[5/95 to 5/00 @ 60 Herbert Circle, Patchogue, NY]

Table A

GFX-CH [1st All-Electric Year 5/8/95-5/7/96]

5/8/95 to 11/7/95	5,202 kWh	\$859 @ 16.5¢/kWh
11/7/95 to 5/7/96	17,560 kWh	\$2,130 @ 12.1¢/kWh
1st Full Year: Total Energy	22,762 kWh	\$2,989 @ 13.1¢/kWh

Table B

GFX-CH [2nd All-Electric Year 5/7/96-5/8/97]

5/7/96 to 11/6/96 (6 mos)	5,106 kWh	\$818 @ 16.0¢/kWh
11/6/96 to 5/8/97 (6 mos.)	15,678 kWh	\$1,950 @ 12.4¢/kWh
2nd Full Year: Total Energy	20,784 kWh	\$2,768 @ 13.3¢/kWh

Table C

GFX-CH [3rd All-Electric Year 5/8/97-5/11/98]

5/8/97 to 11/6/97 (6 mos)	5,925 kWh	\$810 @ 13.7¢/kWh
11/6/97 to 5/11/98 (6 mos.)	14,796 kWh	\$1,844 @ 12.5¢/kWh
3rd Full Year: Total Energy	19,721 kWh	\$2,654 @ 13.5¢/kWh

Table D

GFX-CH [4th All-Electric Year 5/11/98-5/11/99]

5/11/98 to 11/7/98 (6 mos)	5,578 kWh	\$732 @ 13.1¢/kWh
11/7/98 to 5/11/99 (6 mos.)	14,445 kWh	\$1,463 @ 10.1¢/kWh
3/4 of 4th Full Year: Total Energy **10½ Months @ LIPA Rate **	20,023 kWh	\$2,195 @ 10.1¢/kWh

Table E

GFX-CH [5th All-Electric Year 5/11/99-5/11/00]

5/11/99 to 11/8/99 (6 mos)	5,552 kWh	\$ 749 @ 13.5¢/kWh
11/8/99 to 5/8/00 (6 mos.)	14,795 kWh	\$1,484 @ 10.03¢/kWh
3/4 of 5th Full Year: Total Energy	20,347 kWh	\$2,233 @ 10.97¢/kWh

Table F

BASELINE YEAR####
Electricity & Oil Hydronic Heat with GFX

5/6/94 to 11/5/94	3,658 kWh	\$633 + 700 gal. oil [\$895] = 28,700 kWh @ 140,000 Btu/gal
11/5/94 to 5/8/95	4,874 kWh	\$869
Full Baseline Year	8,532 kWh	\$1,528
OIL + ELECTRIC: Total Energy	37,232 kWh	\$2,397 [Note: Includes oil-burner, but no oil-tank insurance.]

Table G
Energy & Cost Comparisons with Baseline Year

	1st GFX-CH Year	2 nd Year	3 rd Year	4 th Year	5 th Year
Site Energy Savings Baseline: 37,232 kWh = 127 mmBtu]	14,470 kWh [50 mmBtu]	16,448 kWh [56 mmBtu]	17,511 kWh [60 mmBtu]	17,209 kWh [59 mmBtu]	16,885 kWh [58 mmBtu]
Cost Increase Over Baseline Year @ 13.2¢/kWh Avg. LILCO Rate	\$592 [+25%]	\$371 [+15%]	\$257 [+11%]	-\$202 [8.4%] @ 10.96¢ LIPA	-\$164
Partial Change May to November	\$226 [Very Hot Summer & Hot Water]	+\$185	+\$177	+\$99	\$116
Partial Change November to May	\$366 [Abnormally Cold Winter -- 30%] [Est. for Normal Winter: +\$138]	+\$186	+\$80	-\$301 Less Than Oil	-\$280 Less Than Oil

NOTES: Burning 700 gallons of oil releases 28,714 kWh [140,000 Btu/gallon @ 3413 Btu/kWh =41 kWh/gallon of oil]. Table D reveals GFX-CH provided a huge site-energy & pollution reductions by eliminating standby loss, oil burner conversion loss, and parasitic heat losses thru utility room vents. If adjusted for a 30% colder winter, and ignoring water heating savings provided by GFX alone, as well as higher AC usage, the older system would have used about 1.8 times as much energy [49,500 kWh vs. 22,762 for GFX-CH from May '95 to May '96]. With hydro and nuclear-power, especially in high rise buildings with sub-metering, GFX-CH's near 100% operating efficiency offers many other advantages [even as a backup for a heat pump system] because: (1) much less air pollution is produced at the point-of-use, (2) much less HVAC loading from water heater standby loss results, (3) pollution from leaky subterranean oil tanks and insurance/cleanup-costs vanish, (4) it's ultra-quiet, clean, compact, and maintenance-free, (5) the "dead-water" problem common to other combination systems vanishes, (6) antifreeze can be used to protect radiant heating loops, (7) a proprietary innovation further boosts the water heater capacity during the heating season, and (8) much less site-energy is wasted, thereby affording GFX-CH a rating advantage per the new guidelines set by the Home Energy Rating System Council (HERSC, EDU January 1997). Additionally, transmission I²R losses, hence utility operating costs, are minimized because GFX-CH automatically reduces peak currents by running longer on colder days, while GFX halves the water heater's AC-current requirements for showering.

