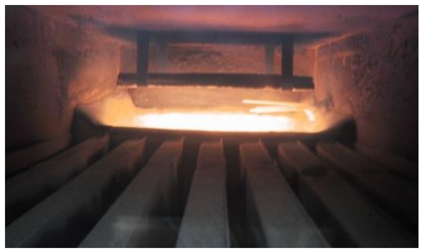
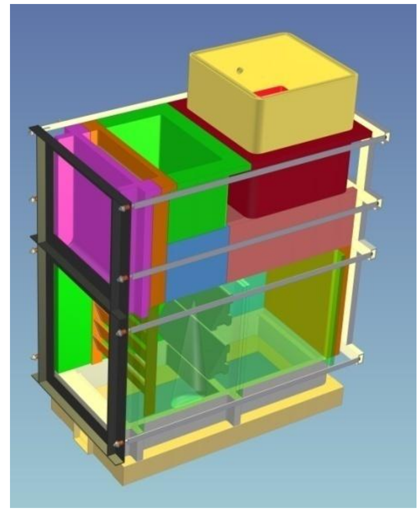
Energy from Waste

Whatever Burns
Can be burned Cleanly





Breakthrough Technology

Burn wet waste fuels super-clean, super-efficient !
Combined Heat & Power ~ Optimized System:
Gasification, Combustion, Heat Transfer,
Quiet Solid State Power, Integrated Computer Controls

< Meet Helen, a hot 376 lb, 7,000 - 50,000 Btu/hr cookstove/air-heater with condensing heat-exchanger, built in 1985. Note hand on stovepipe while pressure cooker steams and combustion chamber is 1500°F

Super Clean & Efficient

On a 95F hot summer day in 1986 Omni Environmental Laboratories tested Helen for the U.S. Department of Energy-Bonneville Power study on “Environmental Impacts of Advanced Biomass Combustion Systems”, with calorimeter room temperature at 68F, creating reverse-draft conditions on low burn. We were burning green fir sawdust of 44% moisture content, on free natural draft with no fans, no catalytic afterburner or stack cleanup of any kind. Particulate emissions were 65 times cleaner than the best woodstove at that time, several times cleaner than the best pellet burner, and considerably cleaner than the average oil furnace. Flue gases were usually so cool that clear water was condensed out in the heat exchanger. Carbon Monoxide emissions in the stack gases were 1/7500th of the Federal Auto Emissions standard, 1/100th of the gas industry's standard for "CO-free combustion," and 1/2 of the EPA's standard for acceptable 24 hour indoor air quality. Since this prototype, four improved versions have been built and tested with everything from household-, office- and greenhouse-waste to soggy bark and rubber. In tests with a newer prototype burning RDF (Refuse-Derived-Fuel) pellets, excess air was brought down to less than 1%, while maintaining low carbon monoxide emissions (0.002%). This is unprecedented in biomass combustion. Only large modern gas furnaces achieve such efficiencies. The latestest prototypes are even cleaner, consistently showing CO emissions undetectable on a 3000 ppm scale. Emissions contain no sulfur and are less acid than rainfall near many fossil-fueled industrial areas of the world.

BIOMASS ENERGY: THE RESOURCE

About 98% of the energy used by mankind today is derived from biomass; it is solar energy stored in plants by photosynthesis. Our most widely used fuel source is nonrenewable fossilized biomass such as coal, oil and natural gas (the latter also possibly generated from within the earth). Plants supposedly store 50 times the total energy consumed by humanity annually, although this ratio is shrinking rapidly. Yet the fossil fuel we earthling humans use daily is calculated to have required more than all the biomass grown on earth yearly to be created! The world's forests are being destroyed at an alarming rate, with tremendous waste of valuable resources and priceless natural beauty of biodiversity. With prudent management and by applying enlightened horticultural practices to reclaim marginal and desert land, biomass can make a large and sustainable contribution to our energy supplies, as we also endeavour to use less energy more wisely.

The amount of unused biomass waste produced in the U.S. and Canada is staggering. There is a huge amount of cheap, usable energy available to us in the form of household and business waste, tree trimmings, sawdust, hogged fuel, demolition and land-clearing waste, logs, chunks, pellets, peat, Refuse Derived Fuel (RDF) pellets, municipal wastes, low-grade waste paper and cardboard products, and all kinds of agricultural waste from corn cobs to rice hulls and sugar cane bagasse. These resources are locally available in various forms everywhere, inexpensive and often free or less.

In our throw-away society, biomass waste is becoming an increasingly costly disposal problem. Governmental agencies have clamped down on indiscriminate dumping and leaching from existing piles of wood & agricultural waste. Slash burning from logging operations is being prohibited totally in more populated areas. Landfills are filling faster and faster. The US EPA's strict new regulations are costing over $1 Million per acre to open new ones and have forced the closing of most of the nation's dumps. Well over 1/3 of our Municipal Solid Waste (MSW) is biomass and other hydrocarbons suitable for fuel, which could replace millions of barrels of imported oil a year. All fossil fuel prices have risen dramatically to escalate at an increasing rate, while costs for biomass fuels are dropping as disposal costs rise. As recycling of paper and plastics becomes a greater expense, its value as fuel far exceeds its recycled value. Waste Biomass promises to be one of our greatest energy bargains for the foreseeable future.

BIOMASS ENERGY: THE DILEMMA

Until now no one has manufactured a biomass/waste combustion system that was clean burning enough to pass strict new emission regulations and also affordable, automated, reliable and capable of burning the greatest variety of fuels, yet the technology has been developed by Larry Dobson**,** who has spent 34 years solving five major problems in biomass combustion technology:

1. Burning a great variety of biomass fuel types, sizes, and moisture content all in the same system
2. Perfecting the combustion process for this wide spectrum of fuels, including plastics and other burnable waste products, to reduce exhaust emissions to well below the most stringent environmental regulations in the world

3. Increasing overall efficiencies of biomass energy from 65% to the high 90s, even when turned down low (1/40th of high heat output) with wet fuels
4. Optimizing the fuel feed, combustion, heat exchange and ash removal into a compact, cost-effective, maintenance-free system that is automated and simple to operate
5. Addressing the needs of the major market: small commercial applications, schools, institutions, conference centers, business complexes, rural communities, urban neighborhoods, agricultural uses and a vast international market including micro energy systems for household and cottage industry energy needs.

Until recently, waste combustion technology has only been cost-effective in large, complex and expensive 30-300 million Btu/hr. systems. They have been built mainly for the disposal of municipal waste and for processing heat and cogeneration in the lumber and paper industry. No one until now has been able to meet the needs of the market for smaller commercial systems, which actually represents the greatest number and best uses for decentralized biomass energy applications.

BIOMASS ENERGY: THE SOLUTION

I have built twelve prototype biomass energy systems since 1973 and patented the design of perhaps the cleanest burning biomass energy system ever tested. It is now possible to utilize large quantities of waste materials and biomass of all types, efficiently converting it into usable energy instead of burying it in costly landfills.

My largest production prototype was an 800,000 Btu/hr commercial hot-air furnace fired by wood waste and other biomass fuels. Its development began as a joint project involving the US Department of Energy, the University of Arkansas, the Arkansas State Energy Office and the Foundation for Organic Resources Management to heat brooder houses at the University of Arkansas poultry research department, burning chicken litter and sawdust for fuel. It incorporated automated fuel feed, a patented integrated pyrolysis/combustion system that preheats combustion air to 1000 - 1500°F in a multi-cavity refractory ceramic heat-exchanger, a highly efficient down-draft counterflow heat-exchanger that condenses the moisture out of the exhaust, and automated programmable electronic controls. This design was further refined and tested by External Power LLC. to operate with a linear Stirling alternator from Sunpower to cogenerate electricity. The tests of our furnace coupled with the heat-engine generator were successful, but the company was unable to manufacture the Stirling engine successfully and went out of business. This and other commercialization ventures are waiting on further funding and involvement of manufacturing companies.

Throughout the world there is a great need for clean conversion of waste to energy in small, decentralized community sites. Existing systems are prohibitively expensive and unreliable. Because my technology is so clean and simple and capable of handling such a diversity of fuels, it is ideally suited for such applications.

Energy users everywhere are looking for ways to cut costs, reduce waste, and comply with environmental regulations. There is a large immediate market for this system in situations where biomass waste disposal is a priority or where the need exists for cheap hot air, hot water or steam. Considering the full, long term environmental costs of fossil fuels, we must look for alternative sources of energy. Biomass is one of the largest contender today. It creates local power, local jobs, local investment and also serves the growing demand for clean waste disposal.

THE TECHNOLOGY

Integrated System

All components of the system are designed to work together for efficiency, compactness, cost-effectiveness, durability, and maintenance-free operation. Gas flow analysis is used to optimize all flow channels, taking into account changes in temperature, volume, viscosity, turbulence, friction, the unique constituents and properties of biomass gases, and the heat transfer properties of the materials used in it's construction. The whole is much greater than the sum of the parts.

Internal Ceramic Heat-Exchanger

Strong, durable, fatigue & shock-resistant refractory ceramics are used in the gasification and combustion areas. A complex of hollow channels and special silicon carbide heat exchangers transmit heat efficiently to the incoming combustion air. Metals are not used in the combusion zone because metals, no matter how exotic, cannot endure the heat and corrosion in conditions of optimum pyrolysis/combustion. High-temperature ceramic fiber insulation is used along with concentric heat-exchanger shells to move the heat where it is needed to optimize gasification and combustion, and to eliminating excessive heat that produces slag buildup and ceramic fatigue.

The thermodynamic properties of these heat-exchangers increase natural draft and reduce the need for exhaust fans (and their tendency to send unburned embers, soot and ash to clog up the heat-exchanger and increase particulate emissions). The heat-exchanger is designed specifically for high-ash biomass fuels, with no horizontal surfaces to collect fly ash.

All soot is burned in the combustion zone. Any remaining fly-ash is removed from the exhaust stream through a combination of gravity precipitation and steam-condensation entrainment, which continuously scrubs the exhaust and heat-exchanger surfaces. Soluble pollutants in the exhaust are precipitated in the condensate where they can easily be neutralized or removed.

Highest Turn-Down Rate in the Industry

A 200,000 BTU/hr model can operate as low as 14,000 BTU/hr with 95% overall-efficiency and over 99.99% Combustion Efficiency. The 800,000 Btu/hr prototype has a 25-to-one turn/down ratio. This allows the unit to operate at an "idle" while continuing to burn extremely cleanly and efficiently, and always be ready to “turn on the coals” when heat is needed.

True Three Stages: Gasify ~ Combust ~ Transfer Heat

Primary gasification, secondary combustion and heat transformation are separately controlled by a central microprocessor. No heat is taken away from the combustion process except to preheat the gasification air to increase the pyrolysis activity, and prevent melting and slagging up of the ash. Even wet fuels with up to 2/3 their weight in water are dried and vaporized (pyrolysed) by the highly preheated incoming combustion air. The additional steam acts as a catalyst, improving mixing, speeding heat-transfer and shortening the flame path. A million Btu/hr stand-alone gasifier has also been designed and partially fabricated.

Gravity Flow Fuel Feed

The system can take any size, shape and configuration of fuel up to 10” without hang-ups. Counterweighted hopper flaps prevent heat and smoke loss through upper hopper, signal status of fuel reserves, turn on fuel feed in automatic feed systems, and facilitate smoke-free loading of fuel.

Controls

All aspects of combustion and fuel feed are monitored and controlled by a state-of-the-art computer. This is especially important with the ever-changing combustion conditions of biomass and waste fuels. The microprocessor analyses data from various inputs such as switches, thermocouples, other temperature probes and an oxygen sensor to continually monitor exhaust and optimize air-to-fuel mixture, refuel and remove ash when needed, and signal when anything needs attention. The ceramic interior is prevented from thermal shock through subtle control algorithms in the microprocessor programming and precise monitoring of the various temperature and position parameters. The hot air systems will operate manually when the power is out, producing through natural convection flow hot air over 300°F hotter than the cool exhaust temperatures!

Wide Application

Because the six stages of fuel-feed, gasification, combustion, heat-exchange, exhaust scrubbing, and computer control are all separate and unique, this technology can serve a variety of useful functions. A system can be designed to produce combustion temperatures hot enough to efficiently operate Stirling heat engines, thermovoltaic electricity generating cells, glass furnaces, foundries and pottery kilns, as well as industrial processes like baking & drying ovens and steam generation. The stand-alone gasifier unit can supply fuel gas to an internal combustion engine, gas turbine or other gas-fueled applications, including transportation vehicles. It would provide an ideal central energy system serving a neighborhood eco-recycling center with integrated cottage industries creating products from melted aluminum and glass, pottery and a mix of the above applications. A household energy system is being designed to burn any local waste fuel or biomass that will fit into the gasifier bin, provide all the hot water, space-heating and electric needs of a household with quiet operation at up to 96% overall efficiency.

This technology needs funding for pre-production prototyping, testing and demonstrations for various models from a household energy system to community recycling energy center applications.

For additional information, visit http://www.fundamentalform.com/html/energy_from_waste.htm or contact:

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RESUME for LARRY DOBSON

Inventor/designer of the Northern Light family of biomass furnaces

From childhood Larry was fascinated with fire and chemistry. After exploring work in research chemistry with Monsanto and other companies, Larry expanded his interest in the alternative energy field. He worked at the Cowdung Gas Plant Research Facilities in Utar Pradesh, India, and continued private research into alternative energy applications; solar, wind, biogas, hydronic, air, and integrated residential systems. In 1977, Northern Light R&D was started by Larry Dobson for the purpose of researching waste to energy systems, combustion technology, alternative energy, appropriate technology, and a variety of other systems relating to the recycling and utilization of the growing quantities of resources entering the waste streams.

Dobson's recent work was developing a hot air furnace for heating poultry houses burning chicken litter, sawdust and other biomass waste materials. This began as a joint project with the U.S.Department of Energy, the Arkansas Energy Office, the University of Arkansas, and the Foundation for Organic Resources Management. For 3 years, the project was funded by External Power, Athens OH, in conjunction with the development of a Linear Stirling Alternator for cogeneration of power and heat. Dobson has been designing a large wood-gasifier to recycle tree stumps, logs, brush and demolition debris into heat and power, and has dreams of building a highly efficient omnifueled gasifier to run cars and trucks on burnable waste.

Dobson's expertise includes:

- 34 years of research and development in the field
- 3D Solid Modeling component design
- Optimization of gas flow, temperature, heat transmission, throughput, fuel handling
- Utilization of recent advancements in refractory materials, oxygen sensor and controls systems
- Designing of integrated controls and coordinating software development
- Development of new approaches to ceramic component design and manufacturing

RELATED WORK & GRANTS FOR RESEARCH & DEVELOPMENT

- Work with Ram Bux Singh in pilot bio-gas plant in India while in Peace Corps, 1966
- Alternative Sources of Energy Magazine, grant, 1977
- Washington State Energy Office, grant, 1987-88
- Meridian Stoveworks, Seattle – redesigned their ceramic tile stove to include a unique vortex turbulator afterburner to achieve low emissions level of 2 grams of particulate per hour, 1987
- Vaagen Timber Products Company, assistance in prototype development, 1988
- US Department of Energy, Energy-Related Inventions Grant, 1989-1991
- Pyro Industries, Burlington, WA – prototype testing, R&D of 1.5MMBtu condensing boiler 1992-95
- US Department of Energy, Commercialization Ventures Program, 1998-2002
- External Power, Athens, OH – R&D of Commercial biomass/waste-fueled cogeneration modules, funded in part by grant from the National Renewable Energy Laboratory's "Small Modular Biopower Project" 2000-02
- University of Minnesota's SE MN Regional Partnership Energy Project grant 2003

PUBLISHED RESEARCH:

- Proceedings of the Weltkongress Alternativen und Umwelt, Vienna, 1980, *A High Efficiency Home Energy System Burning Biomass*
- Alternative Sources of Energy Magazine, 1980, *The Grendle Report*
- The Mother Earth News Guide to Home Energy, 1980, *An Amazingly Efficient Sawdust Stove*
- International Bio-Energy Directory and Handbook, 1984
- Proceedings of the 1986 International Conference on Residential Wood Energy, *High-Tech Non-catalytic Woodstove Design Considerations*
- USDOE-BPA study testing Helen prototype, *Environmental Impacts of Advanced Biomass Combustion Systems, 1988*
- Proceedings of the 1988 Washington Wood Utilization Conference, *A State of the Art Woodchip Boiler*
- Featured in the book, Sexless Oysters and Self-Tiping Hats, 100 Years of Invention in the Pacific Northwest, by Adam Woog, Sasquatch Books, Seattle, 1991
- Biomass Energy - State of the Technology, Present Obstacles & Future Potential, U.S. Department of Energy, Conservation and Renewable Energy, Office of Energy Related Inventions, 1993
- Proceedings of the Conference on Charting Our Energy Future, Pacific Energy Innovation Association, Vancouver, Canada, 11/2000