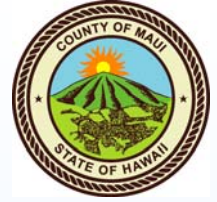




Maui County Energy Expo 2007

“Green Power, Green Future”

November 9, 2007



Maximizing the Potential for Renewable Energy
Waste-to-Energy, Maui’s Untapped Asset

Presented by



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Time Scales and Change

1966 – Nearly free energy

1986 – Still cheap energy

2006 – Today's reality

Thermal Power

World's primary power source

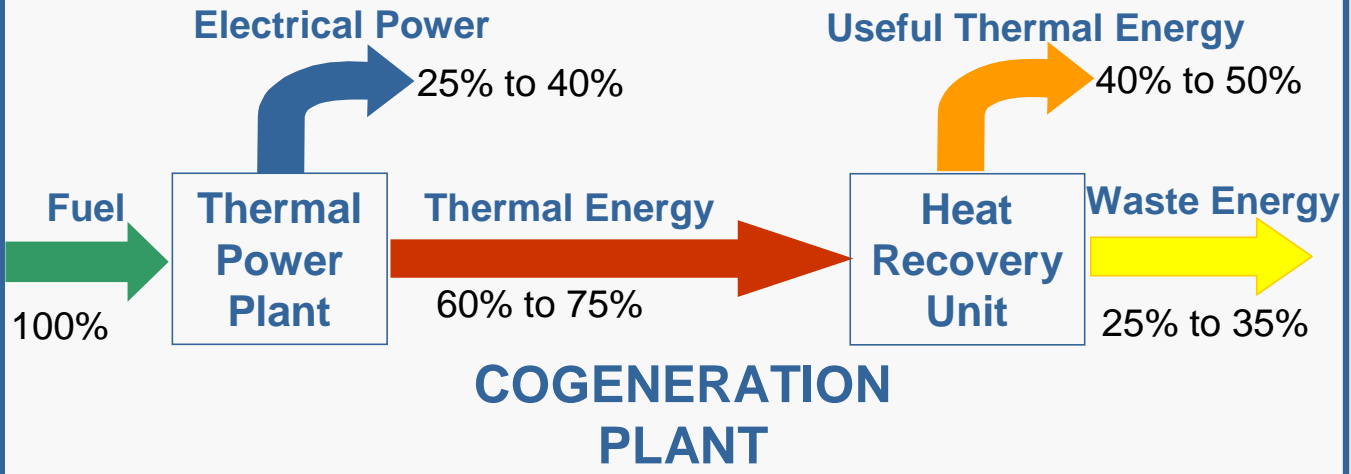
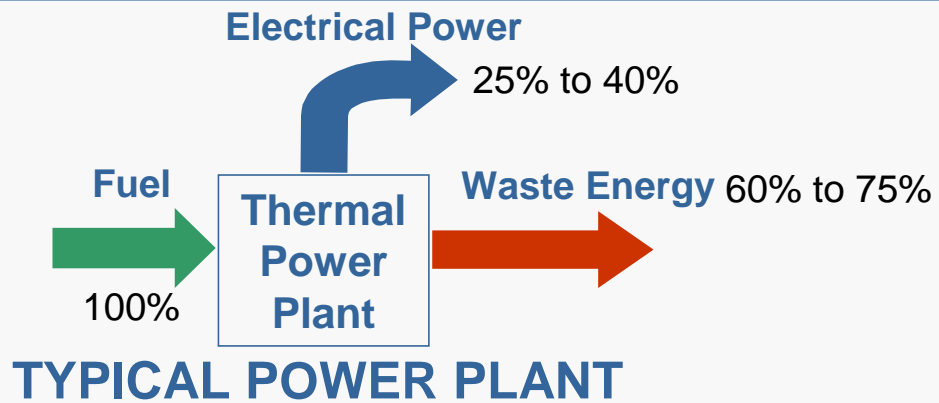
- **Electricity**
- **Transportation (automobiles, trains, planes)**
- **Industry**

Thermal Power

Has technical efficiency limitations.

Requires a “fuel” or a heat source:

- **Fossil Fuels – Oil, Coal, Natural Gas**
- **Nuclear**
- **Waste – Biomass, Municipal Wastes, etc.**
- **Geothermal**
- **Waste Heat**



Heat Rate

Heat Rate = Heat Energy Added per kWh Output

Heat Rate = Btu/kWh

High Efficiency Cogeneration = 5,000 Btu/kWh

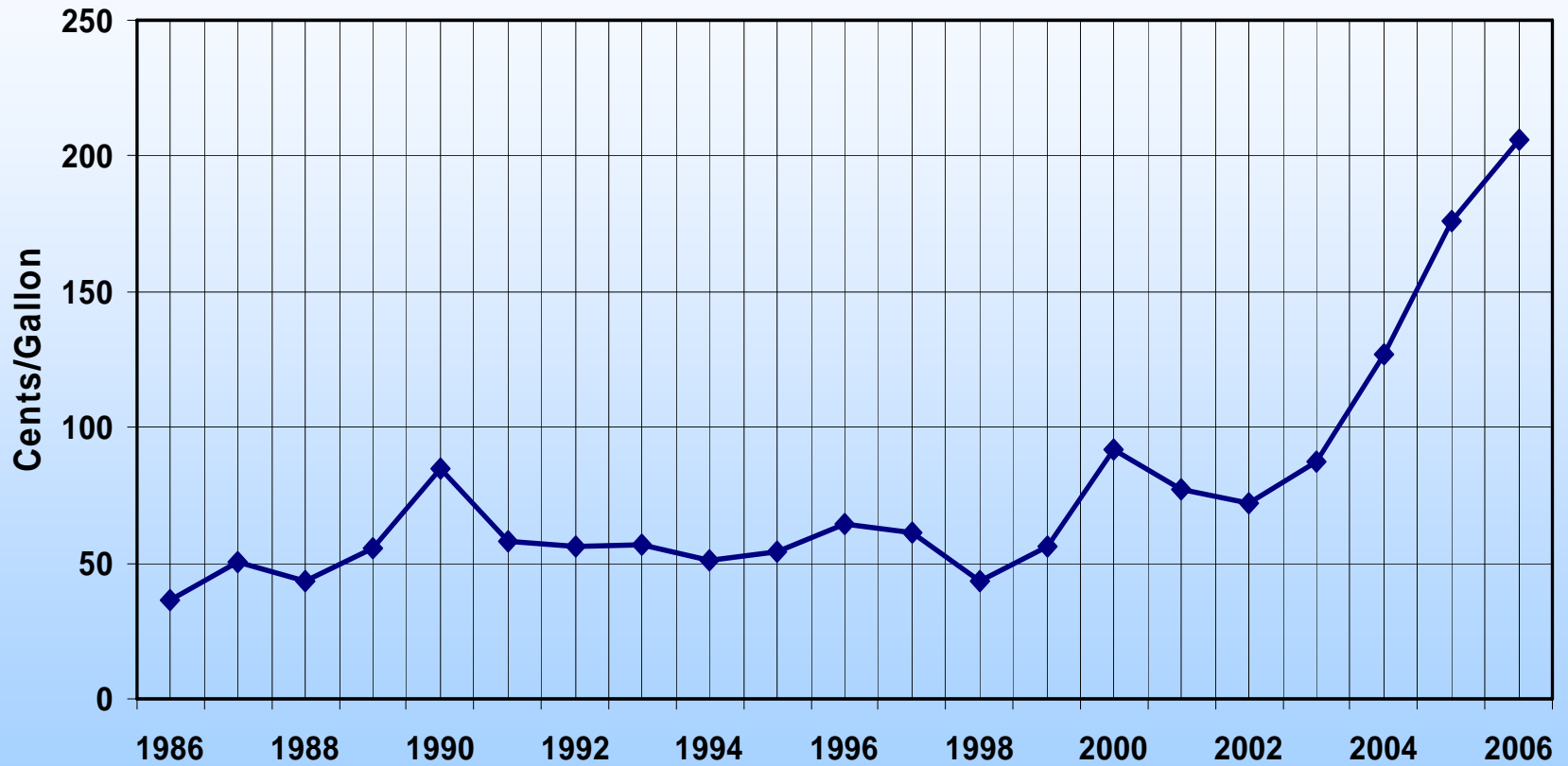
Average Utility Heat Rate = 10,000 Btu/kWh

Biomass Heat Rate = 15,000 Btu/kWh

Waste-to Energy = 20,000 Btu/kWh

Low Sulfur No. 2 Fuel Oil Prices

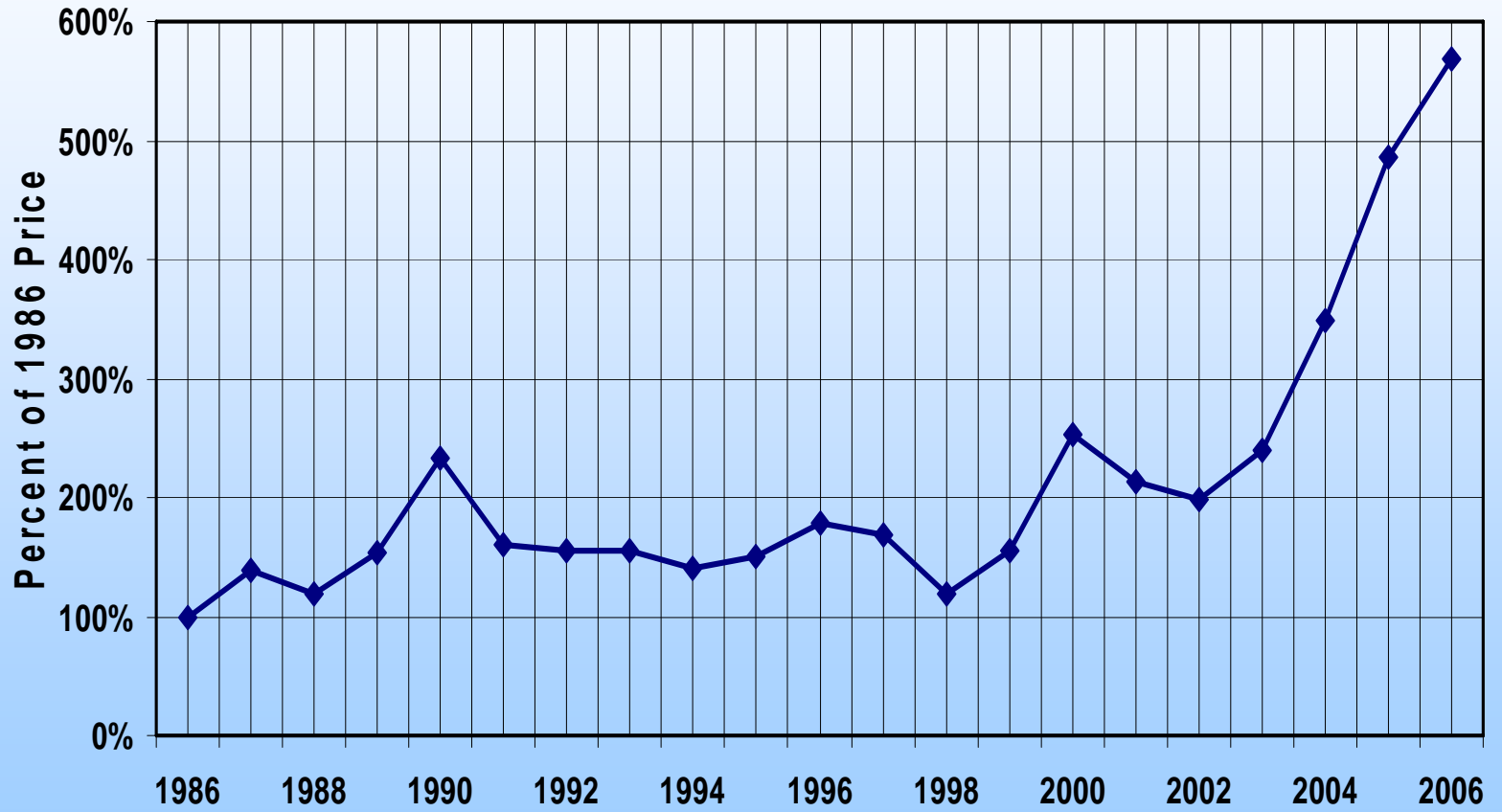
U.S. Energy Information Administration



Low Sulfur No. 2 Fuel Oil

Percent of 1986 Price

U.S. Energy Information Administration Data



Electricity Fuel Cost in Hawaii

	<u>1986</u>	<u>2006</u>
No. 2 Fuel Cost	\$0.36/gal	\$2.06/gal
	\$2.77/MMBtu	\$15.85/MMBtu
Fuel Cost for Electricity (10,000 Btu/kWh Heat Rate)	\$27.70/MWh	\$158.50/MWh

Fuel cost for electricity in Hawaii is the highest in U.S.
and will increase as the world price of oil increases.

Waste-to-Energy Technologies

- **Mass Burn**
- **Refuse Derived Fuel**
- **Modular**

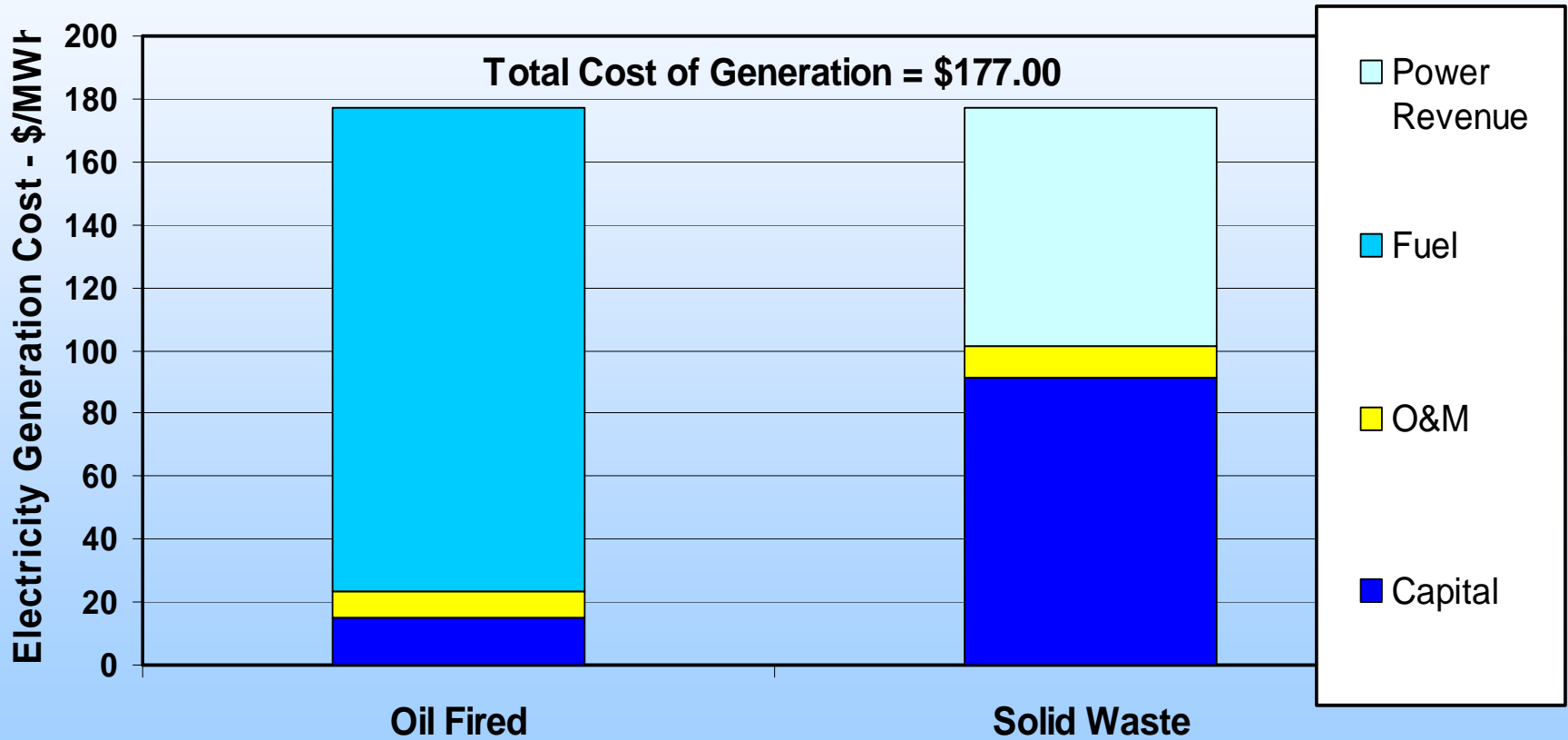
I will be discussing mass burn technology out of convenience. Systems should be selected for specific applications.

Other developing technologies

- **Biological**
- **Thermal/Chemical**

Cost Comparison Oil-Fired Generation vs. Waste-to-Energy

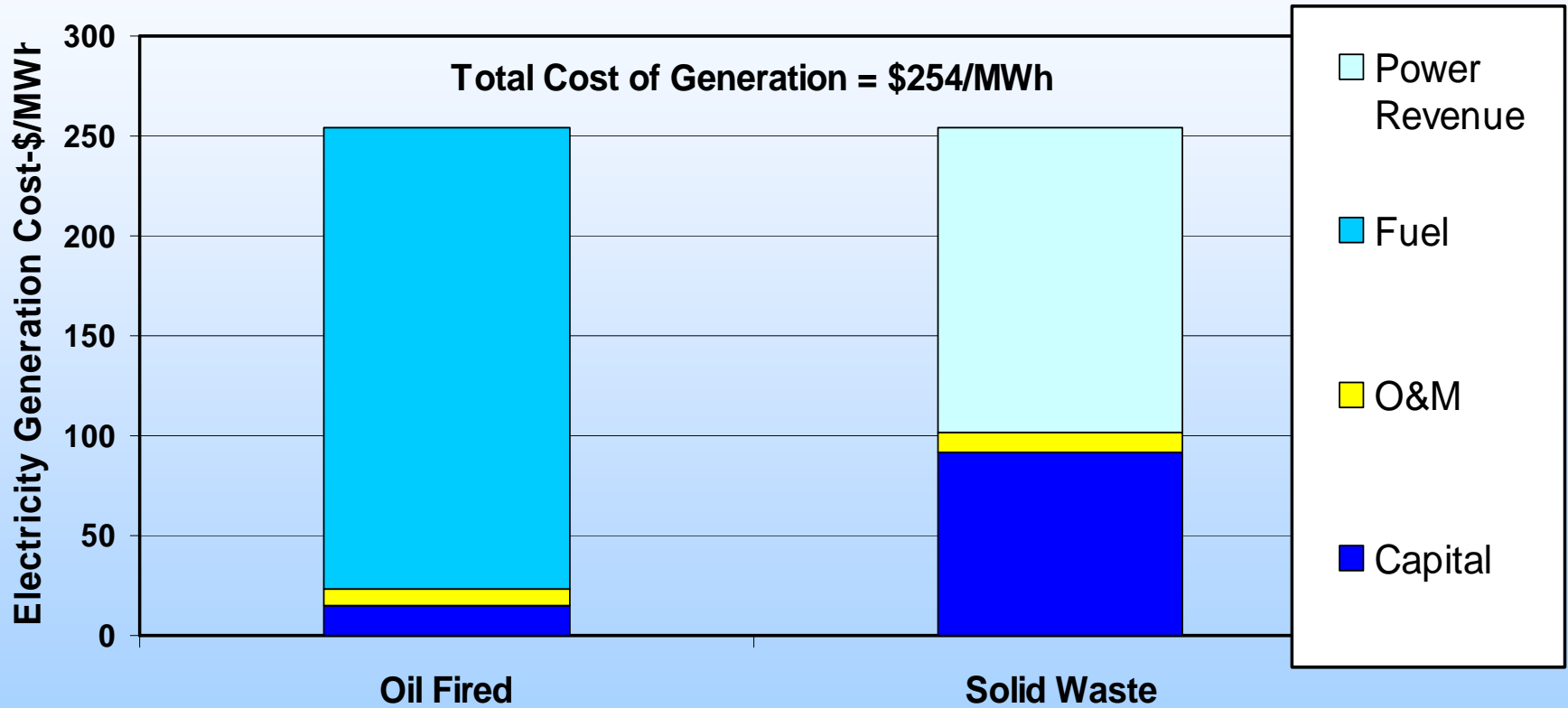
Assumes Oil Cost \$2.00/Gallon



Cost Comparison

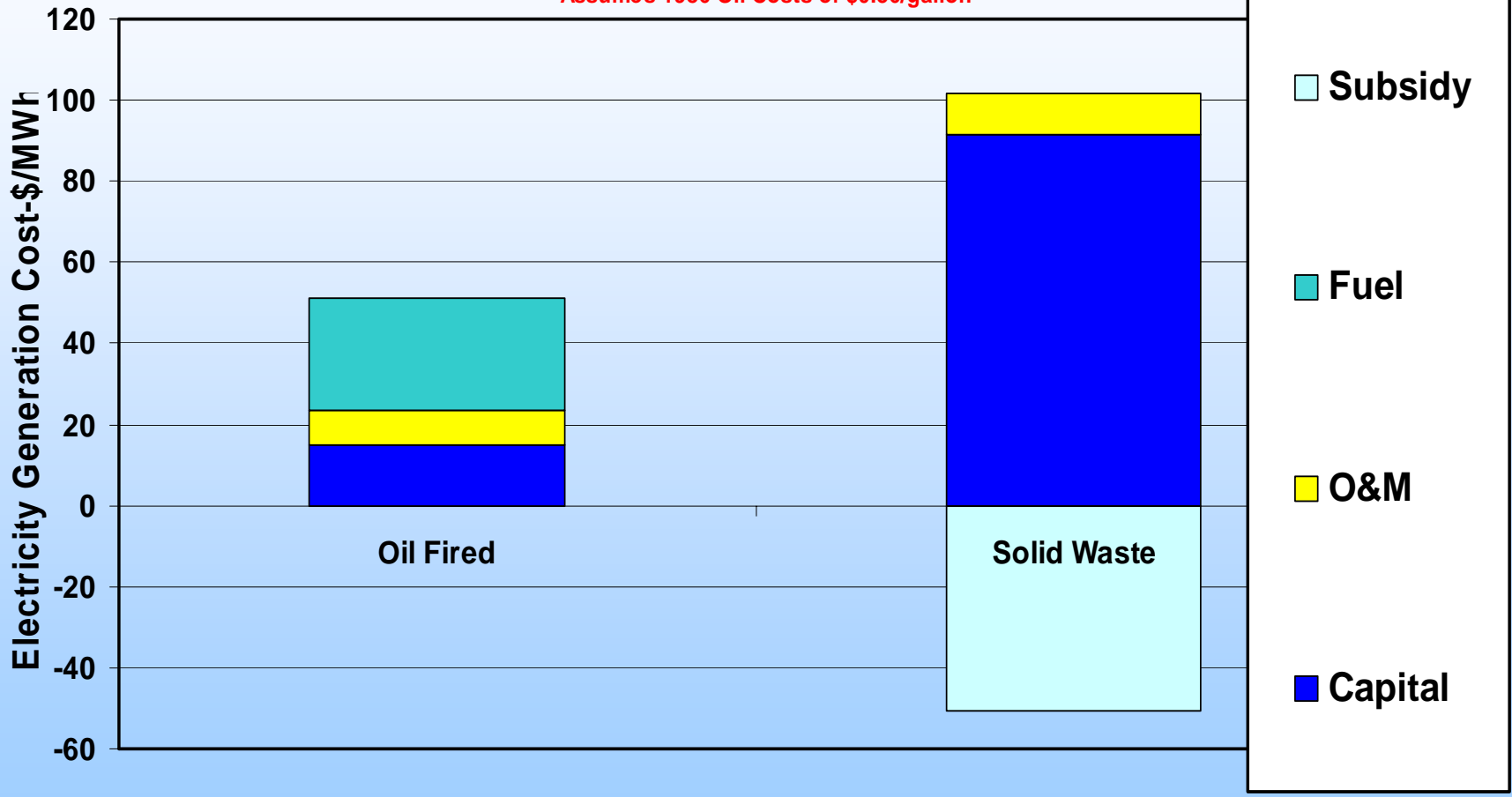
Oil-Fired Generation vs. Waste-to-Energy

Assumes Oil Costs \$3.00/Gallon

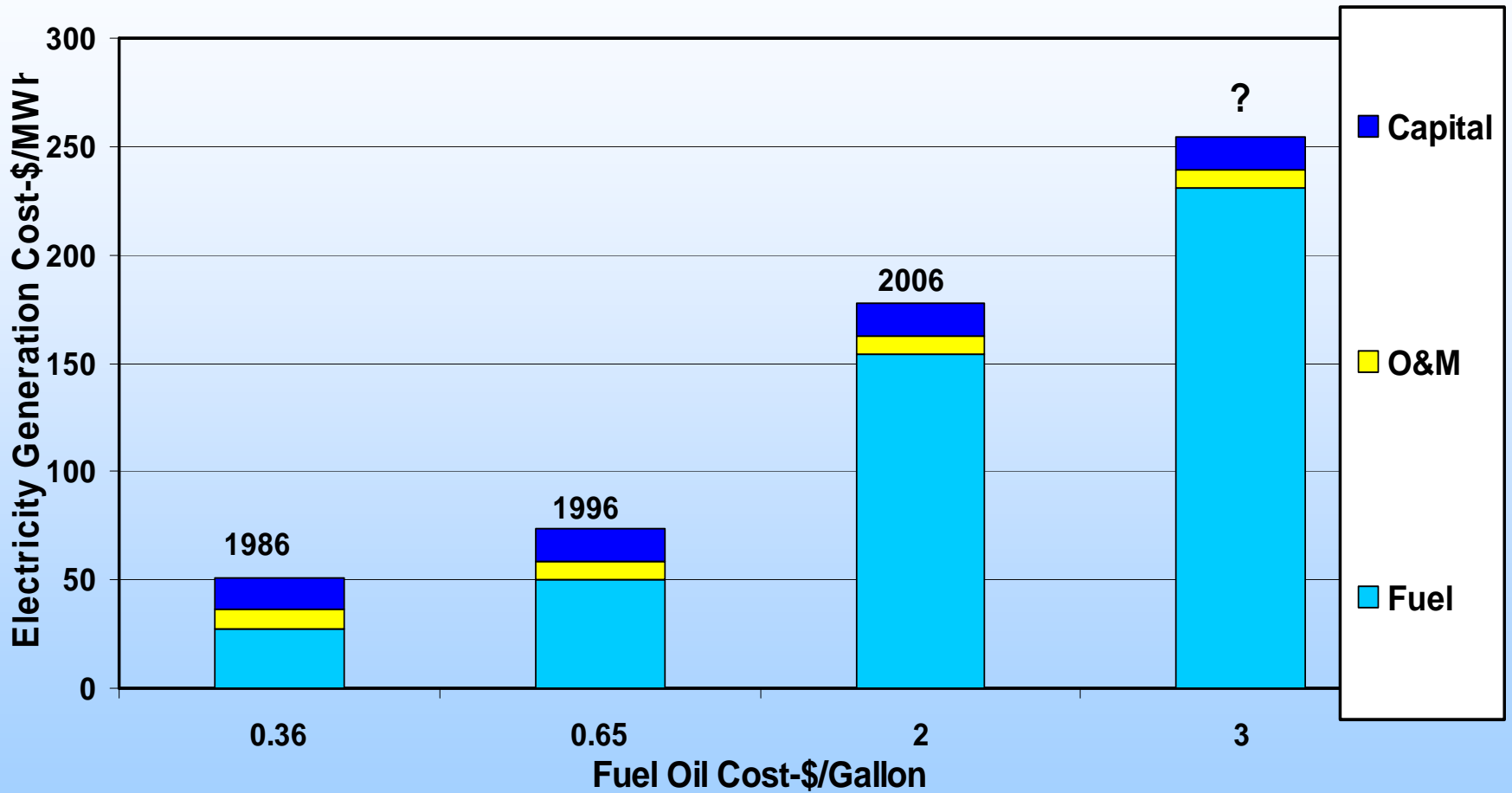


Cost Comparison Oil-Fired Generation vs. Waste-to-Energy

Assumes 1986 Oil Costs of \$0.36/gallon



Oil Fired Generation Cost



Displacing Petroleum with Solid Waste

- Maui County solid waste (204,000 tons/year) could displace about 187,600 barrels of oil annually used to produce electricity on Maui.
- Maui County solid waste could reduce the annual emission of 87,800 tons of CO₂ from the combustion of fossil fuels.

Why Develop Waste-to-Energy on Maui?

- **Eliminate to land disposal of over 5-million tons of solid waste in the next 20-year period.**
- **Minimize groundwater pollution from landfills.**
- **Eliminate landfill gaseous emissions (CH₄, toxics).**
- **Minimize future contingent environmental liabilities.**
- **Minimize land requirements for landfills.**
- **Eliminate about 10% of the fossil fuels from power production.**
- **Eliminate 87,800 tons/year of CO₂ fossil fuels emissions annually.**

Waste-to-Energy projects are environmental projects that produce a valuable energy by-product-electricity.

The value of the electricity produced can reduce the cost of solid waste disposal.

Waste-to-Energy Challenges

- **Capital and O&M Costs**
- **Power Sales Arrangements**
- **Site Selection**
- **Community Acceptance**

Recommendations

- **Continue the development process**
- **Evaluate the best appropriate technology**
- **Evaluate development partners**
 - MECO
 - Independent Developers
- **Take advantage of tax/financial incentives.**
- **Engage the community with quality information.**
- **Do not compromise the environment.**

Recommendations

All environmentally sound, renewable/non-fossil energy systems should be developed including:

- **Biomass/Bio-fuels**
- **Conservation**
- **Ocean Wave**
- **Solar**
- **Waste-to-Energy**
- **Wind**

Tomorrow's energy challenges are opportunities and all of the technologies noted above can play an important role.

Mahalo

Waste-to-Energy Assumptions

100% Increase in Recycling

Plant Size – Tons/Day	620
Availability	90.0%
Annual Solid Waste Disposed-Tons	203,670
Ash Production – Tons/Day	160
Annual Operating Days	329
Capital Costs - \$ Millions	\$93
Land Fill Costs - \$/Ton	\$50.00
Waste-to-Energy O&M Cost - \$/Ton	\$50.00
Ash Disposal Cost - \$/Ton	\$20.00
Plant Electrical Capacity – MW	14.2
Electrical Output Efficiency – MWh/Ton	0.500
Fuel Heating Value – Btu/lb	5,000
Heat Rate – Btu/kWh	20,000
Annual Electrical Energy - MWh	101,835

Waste-to-Energy Power Generation Cost Breakdown

O&M - \$/MWh	\$100.00
Ash Disposal	\$10.32
Savings in Land Fill Costs	-\$100.00
Subtotal O&M Costs	\$10.32
Fixed Capital Charges - \$/MWh	\$91.32
Total Generation Cost	\$101.65

Waste-to-Energy Operating Cost Comparison

Waste-to-Energy O&M Costs	\$10,183,500
Ash Disposal Costs	\$1,051,200
Total Operating Costs	\$11,234,700
Power Revenue	\$7,708,846
Net Cost of Disposal	\$3,525,854
Avoided Cost of Land Filling	\$10,183,500
Disposal Cost Savings	\$6,657,646

Biomass Power Plant – U.S. Mainland



The biomass power plant shown has an operating efficiency that is similar to a waste-to-energy power plant. The heat rates for both types of plants and the energy content of the fuels are similar.

The biomass plant is shown to make the point that the plant pays about \$20.00 per ton for fuel. The plant consumes about 320,000 tons per year at a cost of \$6,400,000.

Conclusion: Solid waste has value as a fuel and the value is set by the cost of other fuels. In Hawaii, the competing fuel is oil and the cost is very high. Thus, solid waste fuel has a very high value in Hawaii.