

# Consumer Guide to Green Energy Choices

a report by Leonardo Academy's Cleaner and Greener<sup>sm</sup> Program

## Executive Summary

Green energy is gaining recognition as we become increasingly aware of the health problems, environmental destruction, and other impacts that result from the pollution caused by our energy use. This growing interest in green energy raises many questions for consumers: *What really is green energy? What kind of green energy should I buy? How much green energy should I buy?* This report was prepared to answer these questions and to help organizations decide what green energy options to recommend to their members. The energy choices consumers make can have a substantial impact on reducing pollution. The use of regulation and legislation to clean up the environment should not be neglected, but expanding the impact of direct actions by consumers will give the environmental improvement stool a third leg to stand on.

The “right” kind of green energy for individual consumers will depend on their values, their willingness to pay for reduced environmental impacts, and their access to reduced-emission options. Given the diversity among both individuals and organizations, it is likely that different individuals and organizations will come to different conclusions about the type of green energy that is right for them. This report accommodates this diversity by examining the issues that underlie green energy choices, developing a framework for making conclusions, and then providing the information needed to make decisions. Organizations can use this information to make green energy recommendations to their members based on the objectives of their organization.

The *Consumer Guide to Green Energy Choices* presents this information in a step-by-step manner. The report:

- P First, examines how consumer energy use causes air pollution and other environmental impacts.
- P Second, provides some context for evaluating the emissions caused by our energy use, the health effects of air pollution, and how much energy the United States uses per capita relative to other countries.
- P Third, identifies green energy types and actions for consumers.
- P Fourth, evaluates the environmental benefits of various types of green energy.
- P Fifth, presents the costs of various types of green energy.
- P Sixth, presents survey results on consumers’ willingness to pay for reduced emissions and their views on different emission reduction options.
- P Concludes by reviewing the highlights of what issues individuals should consider when deciding what kind of green energy to buy, and what issues organizations should consider when deciding what options to recommend to their members.

Consumers cause air pollution both by the energy they use in their homes and vehicles, and by the energy used to produce and deliver the goods and services they buy. The United States uses 2 to 3 times more energy per capita than highly developed countries like France, Germany, England, and Japan. And although the United States contains less than 5% of the world's population, it generates almost 25% of its air pollution.

In the United States, the conventional production of electricity from power plants causes more air pollution than any other source, and contributes to global warming. In 1997, the burning of fossil fuels accounted for 82% of greenhouse gas emissions<sup>1</sup>. Traditional fossil fuel-based energy generation also emits lead, mercury, sulfur dioxide, particulate matter, carbon monoxide, nitrogen oxides, and volatile organic compounds.

Pollution from fossil-fuel based energy generation is hazardous to public health. Toxic compounds, like mercury and lead, poison organ systems and can lead to brain damage and death. Fish consumption advisories have been imposed in parts of the country where lakes and waterways have been contaminated with mercury from electric power plants. Other pollutants cause respiratory and other health problems, particularly in children and the elderly.

Conventional methods of energy generation are also detrimental to the environment. Climate change on a global scale has been attributed to increased emissions of carbon dioxide (CO<sub>2</sub>), a greenhouse gas. A global average temperature rise of 1° to 3.5°C could have serious implications. Possible consequences include melting of polar ice caps; an increase in sea level; and increases in precipitation and severe weather events like hurricanes, tornadoes, heat waves, floods, and droughts. Indirect effects include increases in infectious disease, weather-related deaths, and food and water shortages. All these effects put a stress on ecosystems and agriculture, and threaten our planet as a whole.

Other atmospheric effects of air pollution include urban smog and reduced visibility, which are associated with ozone-forming nitrogen oxides and volatile organic compound emissions. Visibility is also affected by emissions of sulfur dioxide and fine particulates. In addition, sulfur dioxide and nitrogen oxides combine with water in the atmosphere to cause acid rain, which is detrimental to forests and other vegetation, soil, lakes, and aquatic life. Acid rain also causes monuments and buildings to deteriorate.

Energy use and the production and delivery of goods and services also degrade the quality of our land and water resources. Although this report focuses on actions that reduce the environmental and human health effects of air pollution caused by our energy use, green energy actions that reduce air pollution will also reduce solid waste and water pollution. Using our energy resources wisely and efficiently can reduce the air, water, and land pollution that typically results from traditional fossil fuel-based energy generation. This pollution, and its associated health and environmental effects, can be reduced by investing in green energy and electricity options.

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<sup>1</sup> Emissions of Greenhouse Gases in the United States 1997, Energy Information Administration, U.S. Department of Energy, DOE/EIA-0573(97), October 1998.

A consensus has not yet been reached on how to define green energy. Some consider all reduced-emission electricity to be green energy, while others include only renewable energy. Some define green energy as all renewable energy except for hydropower and certain forms of biomass power, while others include small existing hydropower in their definition. For the purposes of this report, we used a broad definition of green energy to include all options that reduce the pollution and other environmental impacts caused by a consumer's energy use, as compared to the current generation mix.

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*Green energy is defined as energy that is produced and used in ways that reduce the pollution and other environmental impacts caused by consumer energy use. Green energy includes more efficient energy production and end use, and energy generated from renewables and cleaner fuels.*

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As consumers, we have many green energy options available to us that reduce the pollution caused by our energy use. Conserving energy is one way we can reduce our emissions—many of us already turn off lights when not in use and adjust the thermostat a couple degrees up or down depending on the season. But beyond energy conservation, what can we do to reduce our emissions?

### **Green Energy Strategy #1: Make Our Energy Use More Efficient**

Increasing energy efficiency around the house and office is one option that scores high in both availability to consumers and environmental benefits. Buying energy-efficient appliances and light bulbs, switching to natural gas, and installing insulation and programmable thermostats are just a few of the ways consumers can be energy-efficient. When buying new appliances compare Energy Guide labels and look for the Energy Star—a label given by the U.S. EPA and U.S. DOE to products whose energy efficiency rating is best in its category and also exceed the minimum federal standards. To find out how you can further improve the energy efficiency of your home, consider having a home energy audit done.

Energy efficiency reduces the environmental impacts that result from the entire process of producing and delivering energy to consumers, including fuel extraction, combustion, transmission, and distribution (Table 1). Energy efficiency is also a low cost way to reduce emissions. Most efficiency measures more than pay for themselves with the energy savings they provide. Implementing energy efficiency measures has the potential to reduce emissions from household electrical consumption by 30% (Figure 2) and save the average consumer up to \$23 per month (\$278 per year) on their electricity bills (Figure 1).

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*Energy efficiency measures have the potential to reduce emissions that result from household electricity use by 30%, with a cost savings of up to \$23 per month.*

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As consumers, we should do as much to increase the efficiency of our energy use as we are comfortable with, but since efficient energy use can only affect a portion of total energy use, we should not stop there.

**Table 1 Summary of Environmental Impacts of Options for Reducing the Emissions that Result from an Average Household’s Energy Use**

Types of Green Energy		Environmental Impacts Reduced					
		Air pollution <sup>1</sup>	Electric transmission and distribution	Fuel transmission and distribution or transportation	Electric generating plants	Fuel extraction	Goods and services <sup>2</sup>
Emission Offsets <sup>3</sup>		Yes (100%)	Yes	Yes	Yes	Yes	Yes
Increased Energy Efficiency		Yes (20-30%)	Yes	Yes	Yes	Yes	No
Renewable Generation (wind, solar, etc.)	On-Site	Yes (100%)	Yes	Yes	Yes	Yes	No
	Off-Site	Yes (100%)	No	Yes	Yes	Yes	No
Fuel Switching: Coal to Biomass Fuel Generation		Yes <sup>4</sup> (100%)	No	Maybe <sup>5</sup>	No	Yes	No
Generation Efficiency Improvements		Yes (Varies)	No	No	No	Yes	No
New Generation Technologies (IGCC & IGFC)		Yes (4-28%)	No	No	No	Yes	No
Fuel Switching to Natural Gas Generation		Yes (30-60%)	No	No	No	No	No
Generation End-of-Pipe Actions		Yes (Varies)	No	No	No	No	No

<sup>1</sup> Percentages reflect the average U.S. household’s CO<sub>2</sub> emission reduction potential from electricity

<sup>2</sup> Impacts of energy used to produce and deliver the goods and services we buy

<sup>3</sup> Buying and retiring emission reduction credits offsets the emissions caused by household energy use

<sup>4</sup> Impact varies by type of emission and combustion process

<sup>5</sup> Dependent on distance from fuel source – no, if distant source; yes, if nearby source

## Green Energy Strategy #2: Buy Cleaner or Renewable Electricity

Buying cleaner or renewable electricity has positive emission reduction benefits, but availability can be restricted by the status of electric industry deregulation. In areas where utilities still have a retail monopoly, green electricity is only available to consumers if the utility chooses to make it available, or if regulations require that it be made available. In this situation, any green electricity services are only available at non-competitive prices set through the regulatory process. Where utility deregulation has created fully competitive retail energy services markets, green electricity can be purchased at prices set by the competitive market. So where the electricity market is competitive, the green electricity is likely to be available at lower prices than where the utility still has a retail monopoly.

An analysis of electricity generation options shows that renewable technologies can economically turn wind, sunlight, and organic matter (biomass) into electricity and other useful forms of energy. 100% reductions of CO<sub>2</sub> emissions (Figure 2) from our electricity consumption are possible using a number of different renewable technologies. Of these, proven renewable energy alternatives such as wind- and solar-fueled generation continue to gain market penetration and enjoy cost decreases over time. Wind power in particular has emerged as an attractive and viable electric generation option for consumers. Buying 100 percent proven available renewable electricity has an incremental cost (as compared to the current

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*In a competitive market, the average U.S. household could eliminate all of their CO<sub>2</sub> emissions from household electricity use for an additional \$3 per month.*

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generation mix) of about 0.4 to 3 cents per kWh for wind and biomass (fluidized bed combustion) electricity. This means that the average U.S. family could eliminate all the carbon dioxide (CO<sub>2</sub>) emissions caused by their household electricity use for less than \$3 more per month or around \$34 more per year (Figure 1) in a *competitive* market.

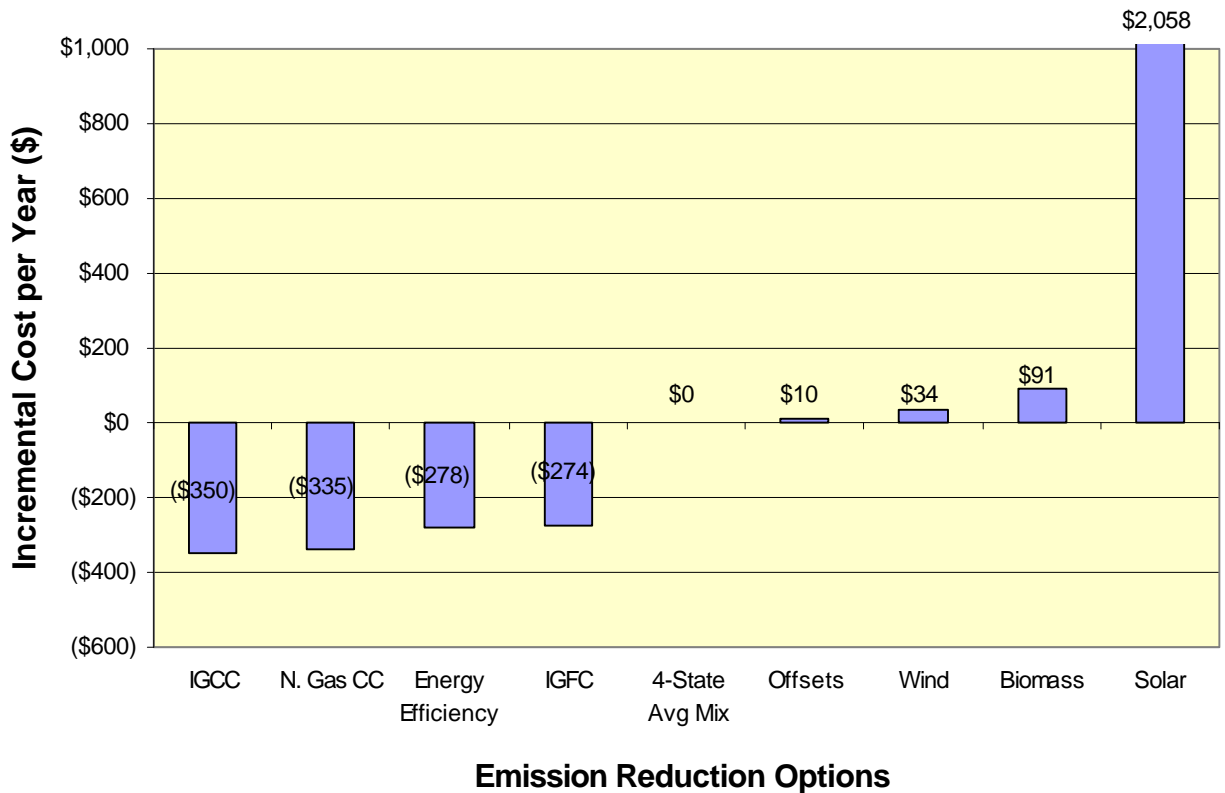
Several emerging renewable technologies such as biomass feed integrated gasification combined cycle (Biomass-IGCC) can produce electricity at incremental cost savings to consumers. As expected for Illinois, Iowa, Minnesota, and Wisconsin, large scale photovoltaic generation is a more expensive way to produce cleaner electricity at approximately \$2000 more per year. However, this technology offers an alternative for isolated consumers located large distances away from the power grid.

Figure 1 shows that on a cost basis, newer emerging generation technologies such as integrated coal gasification combined cycle (IGCC) and integrated gas fuel cells (IGFC) are very cost-effective. However, these two technologies are not widely utilized and offer low emission reduction potentials of 4% and 28%, respectively (Figure 2). Fuel switching to natural gas-fired generation and energy efficiency options provide cost-effective consumer approaches for reducing emissions with emission reduction potentials of 60% and 30%, respectively.

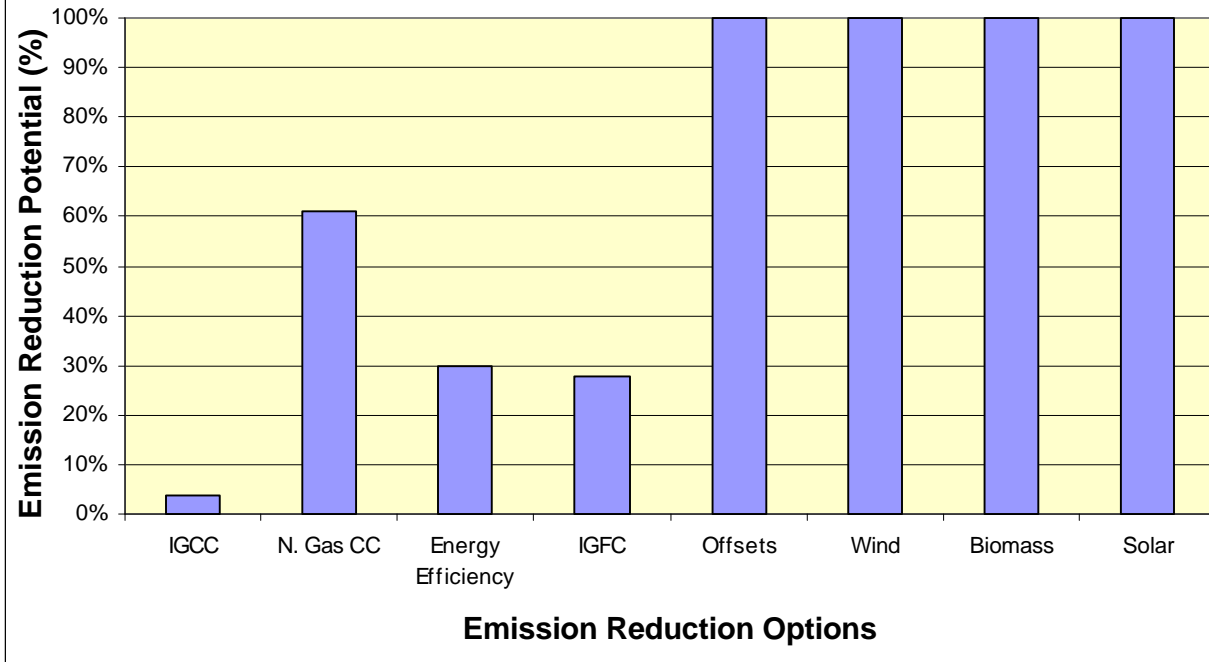
**Key to emission reduction technologies in Figures 1 and 2:**

IGCC = Integrated Gasification Combined Cycle  
 N. Gas CC = 215 MW Natural Gas Combined Cycle (stand alone)  
 Energy Efficiency = Potential for household efficiency measures  
 IGFC = Integrated Gasification Fuel Cell  
 Offsets = CO<sub>2</sub> Emission Offsets (voluntary market)  
 Wind = Average wind turbine  
 Biomass = Atmospheric Fluidized Bed Wood-fired Biomass  
 Solar = Fixed Flat Plate Photovoltaic (5 MW) - dispersed connection  
 4-State Avg Mix = Average electricity generation mix for the states of Illinois, Iowa, Minnesota, and Wisconsin

**Figure 1 Average Family's *Incremental* Electricity Cost per Year in Post-Restructuring and Paid-Off Stranded Cost Environment**



**Figure 2 Average Family's Electricity CO<sub>2</sub> Emission Reduction Potential per Year in a Post-Restructuring and Paid-Off Stranded Cost Environment**



### **Green Energy Strategy #3: Buy and Retire Emission Reduction Credits**

Sources of air pollution that reduce their emissions below their required limit (cap) may receive saleable credits for their reductions. Emission reduction credits reward those who take action to reduce their pollutant emissions and therefore encourage pollution reduction actions. Credits for emission reductions provide an incentive to find the most cost-effective way to reduce emissions, since once an emission reduction credit is earned, it can be sold on the open market. Markets for emission reduction credits or emission allowances can be created by regulation (the sulfur dioxide market for example) or voluntarily (the current market for greenhouse gases).

Emission reduction credits can be used to reduce pollution. Instead of reselling emission reduction credits to sources of air pollution that will use them to compensate for their pollutant emissions, allowances can be retired, *without* emitting any pollution. Once an emission reduction credit is retired, it can no longer be bought, sold, or used to offset pollution. Purchasing and retiring emission reduction allowances reduces the amount of pollution that is discharged to the atmosphere for regulated markets, and creates future pollution reduction potential for voluntary markets.

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*Traditionally, in areas of tight environmental controls, new sources of air pollution are required to **offset** their new emissions with a reduction in emissions from an existing source. Similarly, consumers can "**offset**" the pollution caused by their energy use by buying and retiring the emission reduction credits created by someone else.*

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The third green energy strategy allows consumers to take advantage of emission reduction credit markets. Buying and retiring emission reduction credits produced by energy efficiency or renewable energy projects allows consumers the chance to:

- P Influence public policy decisions to implement market-based pollution reduction strategies
- P Give value and financial incentive to the pollution reduction actions made through energy efficiency and renewable energy projects
- P Strengthen emission reduction markets
- P Reduce the negative environmental impacts that result from the entire process of energy production and distribution, including energy use to produce and deliver the goods and services purchased by consumers

Buying and retiring emission reductions provides many environmental benefits (Table 1). Energy efficiency and renewable energy projects reduce the negative environmental impacts caused by the production and delivery of energy to consumers, as well as provide emission reductions which can be purchased by consumers. Increasing end use energy efficiency provides many environmental benefits as well, but it is difficult for consumers to reduce their indirect emissions caused by the production and delivery of goods and services they buy. Buying emission reduction credits has an added advantage, it allows consumers to offset their net emissions, including those produced by goods and services purchased, by 100 percent.

Green energy in the form of emission reduction credits can be purchased in the competitive marketplace, so competition will eventually drive the price of emission reductions down to the point where supply and demand are balanced. Buying emission reduction credits lets consumers conveniently offset the emissions, caused by both their direct and indirect energy use, as much as they want at a low competitive market cost. For example, an average U.S. family's CO<sub>2</sub> emissions from their household electricity consumption could be offset for less than \$1 per month, or \$10 per year (Figure 1). An average U.S. family's total CO<sub>2</sub> emissions, including emissions from transportation and the goods and services purchased, could be offset for less than \$5 per month (\$56 per year).

To demonstrate the impact that consumers can have on reducing pollution, Leonardo Academy has instituted a program that lets consumers buy green energy in the form of making a donation (all U.S. donations are tax-deductible) to buy and retire emission reduction credits. For pollutants that have established national emission trading systems in place, the Cleaner and Greener<sup>sm</sup> Program buys emission reductions from within that trading system. For example, sulfur dioxide allowance auctions are conducted by the Chicago Board of Trade. For pollutants like carbon dioxide, that do not have established emission trading systems, the Cleaner and Greener<sup>sm</sup> Program buys emission reduction credits that are reported<sup>6</sup> according to the Multiple Pollutant Emission Reduction Reporting System developed by Leonardo Academy with funding from the U.S. EPA. Any emission reduction credits that are purchased are retired. Once retired, they cannot be sold, traded, given away, or otherwise used to offset pollution.

The Cleaner and Greener<sup>sm</sup> Green Energy Program shows that there are low cost pollution reduction options available, encourages increased energy efficiency and renewable energy, and shows that there is public support for taking action to reduce pollution.

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<sup>6</sup> Emission reductions are reported under the Voluntary Reporting Program of the U.S. Department of Energy - Energy Information Administration (1605(b) of the Energy Policy Act).



The bottom line for consumers is that they can easily take direct action to reduce emissions at a modest cost. Our survey results show that environmentally-oriented consumers are willing to spend \$33 more per month to reduce environmental pollution, although consumers also need to feel like they are getting a value for their premium and that the dollars they spend will make a difference.

The demand for cleaner energy sources is already present. What is needed now is more education and access to these cleaner sources. Electricity providers should be able to offer cleaner electricity to consumers for little or no additional cost. The resources are currently available for a supplier to respond to an educated consumer market.

When we incorporate energy conservation and efficiency measures in our own homes we decrease energy consumption. These energy savings increase our disposable income, which leads to growth in employment since most of the income is spent locally on consumption of goods and services instead of flowing out of state to pay for fuel imports. Renewable generation built in-state also has positive economic impacts by eliminating the cost of paying for out of state fuel products. Buying emission offsets helps people and organizations that implement energy efficiency, renewable energy, sequestration, and cleaner generation projects to pursue more and bigger projects. You also help put people to work installing, designing, manufacturing, and developing the equipment needed to carry out these cleaner energy projects.

Consumers can also help the environment by supporting environmentally beneficial regulation and legislation. They can do this by giving with their time and money to organizations that are supporting smart, effective policies for promoting cleaner energy sources. These policies include measures such as renewable portfolio standards, rewarding all pollution reduction actions with allocations, net metering, public benefits funding, and fair rules between all energy sources (even playing field). Our survey results showed high support for many of these policies by environmentally-minded consumers as desirable ways to clean up the pollution our energy use causes. This report provides information which can be used to add support for these policies but was geared towards helping individual consumers take direct actions towards reducing their own air pollution.

Regardless of the combination of emission reduction actions you choose, by incorporating just a little of each of the Green Energy Strategies, you can show that consumers want reduced environmental emissions, that consumers are willing to pay to reduce emissions and finally, that emission reductions are available at a lower cost than most people think. Your actions can produce direct environmental benefits—by reducing the demand for emission-producing fossil-fueled electricity generation, you reduce the environmental impacts from energy production and delivery. Your actions also help the marketplace, regulators, and legislators do more to reduce pollution.

So read this report, and choose a mix of increased energy efficiency, renewable electricity, and emission offsets that works for you. If you represent an organization, recommend that each of your members implement a mix that fits your organization's objectives. Start leading the way today to a cleaner environment for you, your children, your grandchildren, and future generations.

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