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WELCOME	
KAREN NAKAMURA	1
ENERGY SUPPLIES	
JACK ZAGAR	2
<i>The End of Cheap "Conventional" Oil</i>	3
THE ECONOMICS OF ENERGY EFFICIENCY AND RENEWABLE ENERGY	
DR. LEROY LANEY.....	18
<i>A Peer Review of <u>The Economic and Fiscal Impacts of the Hawaii Energy Conservation Income Tax Credit</u> By Thomas A. Loudat, Ph.D., Revised January 27, 1997</i>	19
DR. TOM LOUDAT.....	27
<i>The Economic and Fiscal Impacts of The Hawaii Energy Conservation Income Tax Credit</i>	28
OTHER STATES' STATUTORY AND REGULATORY POLICIES	
MARWAN MASRI.....	38
<i>The California Energy Commission's Renewable Energy Program</i>	39
MATTHEW H. BROWN.....	46
<i>Renewable Energy Policies in Other States</i>	47
ROBERT MCGUFFEY	53
<i>North Carolina Policies and Programs for Energy Efficiency and Renewable Energy</i>.....	54
MICHAEL L. NEARY.....	63
<i>Arizona Public Policy - Solar and Renewable Energy</i>	64
FEDERAL POLICIES	
PETER DREYFUSS.....	70
<i>Federal Policies and Million Solar Roofs</i>	71
ARITHMETIC, POPULATION, AND ENERGY	
DR. ALBERT BARTLETT	78
<i>Reflections on the Twentieth Anniversary of the Paper, "Forgotten Fundamentals of the Energy Crisis"</i>	79
<i>Forgotten Fundamentals of the Energy Crisis</i>	83
<i>Additional and Updated Information</i>	104
WHAT'S HAPPENING IN HAWAII	
RUBY HARGRAVE	
<i>Honolulu Community Action Program</i>	115
TERRENCE R. GEORGE	
<i>Solar Water Systems Benefit the Working Poor Three Different Ways: A Case Study of Consuelo Foundation's Self-Help Housing Initiative in Waianae, Oahu</i>	117
CULLY JUDD	
<i>Solar in Hawaii</i>	121
DAVE WALLER	
<i>HECO's Energy Solutions Program: Partnership that Creates and Supports Local Businesses</i>	122
RAY STARLING	
<i>Priming the Energy Pump in Hawaii</i>	126
GLENN CHING	
<i>Being Cool at Iolani School</i>	130

Robert McGuffey

Solar Engineering Specialist
North Carolina Solar Center, North Carolina State University

Mr. McGuffey has worked since 1995 in commercial and industrial energy conservation outreach with both the Industrial Assessment Center and the North Carolina Solar Center. During that time, he has participated in industrial audits with the Industrial Assessment Center and has conducted commercial and industrial audits for the North Carolina Solar Center going to more than 50 facilities. He has managed the Solar Center's Commercial Industrial Program for the last 4 years. In parallel with his commercial and industrial outreach work, he has been working on other research projects. He conducted a commercial, industrial study for the National Renewable Energy Laboratory. He and Mr. Stevens have been testing a roof integrated concentrated solar collector system for Duke Solar. He has worked with this project at North Carolina State University and at Sandia National Laboratory in New Mexico. Prior to joining the North Carolina Solar Center staff, he had 20 years work experience in the compressed air and petroleum industries.

North Carolina Policies and Programs for Energy Efficiency and Renewable Energy

Presentation by Robert McGuffey, Solar Engineering Specialist with the North Carolina Solar Center of the University of North Carolina.

North Carolina Policies and Programs for Energy Efficiency and Renewable Energy

North Carolina Energy Office

- /// Created by Legislator
- /// Reaction to 70's oil crisis
- /// Purpose to cope with energy related emergencies
 - over-dependence on foreign oil
 - natural disaster energy outages

The Energy Division was created by the N.C. Legislature to help North Carolinians cope with energy-related emergencies – emergencies that can arise from an over-dependence on foreign oil or from energy outages created by natural disasters.

The Division has pioneered a series of programs to develop newer and better technologies that preserve our fuel supplies while helping to protect the environment. Division programs have provided direct assistance to people in every one of the state's 100 counties, helping families and individuals save on energy bills.



Residential –The Energy Office provides workshops, seminars, brochures, manuals and other sources of information to help reduce spending on heating and cooling.

Industrial and Commercial – Find out about energy audits, steam trap surveys, humidity control, motor efficiency and other technologies that help small and large business cut operating costs.

Transportation– Our transportation system is on the brink of dramatic changes. Find out about alternative fuel vehicles, electric cars, fuel cells, and other changes coming down the road.

Agriculture – Our programs range from fish barns and preventive maintenance to biomass and postharvest technologies. The bottom line is increased profits for North Carolina farmers.

Students & Schools – Topics include science facts, school construction, daylighting, student energy patrols and success stories of schools that have saved taxpayers big money on energy costs.

Energy-related Emergencies – Tips and guidelines on what to do in energy-related emergencies created by hurricanes, tornadoes, snowstorms, ice storms, extreme heat and other forms of severe weather.

Program and Policy Areas

- /// Residential
- /// Industrial and Commercial
- /// Transportation
- /// Agriculture
- /// Students & Schools
- /// Energy-related Emergencies



Residential Programs

- ⚡ Geothermal Heat Pump Education
- ⚡ North Carolina Solar Center
- ⚡ Weatherization Assistance and Heat Appliance Program
- ⚡ Update State Building Energy Codes
- ⚡ Tips for Saving Energy



Of the program areas mentioned above, the Residential and Industrial-Commercial offer the most opportunities for energy efficiency recommendations and renewable energy applications.

Energy Division residential programs apply new technologies, provide assistance to residents, and encourage the adoption of energy conservation and renewable technologies.

Geothermal Heat Pump Education - educational opportunities and materials that describe residential geothermal heat pumps.

NC Solar Center serves as a clearinghouse for information, technical assistance and education on

solar and renewable energy technologies.

Weatherization provides funds to local community action agencies for the purchase and installation of insulation, weatherstripping and other weatherization improvements Repair and Replacement Program (HARRP), offers assistance to families to repair, replace, or perform energy conservation.

Building Energy Codes - Workshops will be developed and presented throughout the state on the N.C. Residential Energy Codes. The building code is a simplified version of the 1995 Model Energy Code (MEC), and it is mandatory statewide. Training is provided for building professionals – such as code inspectors, architects, engineers, builders, and insulation contractors – to ensure that residences in North Carolina are energy efficient.

Tips for Saving Energy - Energy Division staff has assembled a list of energy-saving practices that will help you save energy and lower your utility bills. Recommendations are listed for winter and summer seasons. Refer to the Publications section for printed information and web-based articles.

Industrial and Commercial Programs

- ⚡ Center for Energy Research and Technology
- ⚡ Methane Recovery
- ⚡ Rebuild America
- ⚡ Energy Management Technology and Technical Assistance Program
- ⚡ Commercial and Residential Building Codes
- ⚡ Business Energy Improvement Program
- ⚡ Steam Traps
- ⚡ Climate Wise



Center for Energy Research and Technology –

The Center for Energy Research and Technology at N.C. A&T State University is researching energy use and energy efficiency in buildings and industrial processes.

Methane Recovery – The Division has led several methane-recovery efforts that have helped curtail the release of the greenhouse gas into the environment and led to technologies that use methane for fuel.

Rebuild America – The program helps municipalities offset the trend of declining downtowns through cooperative local efforts that boost downtown business. Help includes funding and technical assistance.

Energy Management Technology and Technical Assistance Program – For the commercial and industrial sector, the program, located at the Industrial Extension Service at North Carolina State University, helps facility managers and maintenance supervisors reduce operating costs.

Commercial and Residential Building Codes – Workshops help builders, contractors, building code officials, developers and design professionals learn the latest in energy technologies and techniques.

Business Energy Improvement Program – The loan program helps businesses make building improvements that produce a quick energy-savings return on the money invested.

Steam Traps – With the state's industrial base in mind, the Division designed a steam trap program that helps companies identify energy trouble spots in the production process. Companies in the state have been able to reduce their steam losses, which often add dramatically to a company's energy costs.

Climate Wise – A coalition of state and federal government agencies, the Climate Wise Program aims to protect the environment by encouraging businesses to take part in projects that improve energy efficiency and waste reduction, while cutting back on energy bills dramatically.

North Carolina Solar Center

Established in 1988

Partnership

- state government
- NC State University
- industry
- non-profit community



Founded in 1988, the North Carolina Solar Center represents a unique partnership between state government, NC State University and the solar industry and nonprofit community. Recognizing the need for a central clearinghouse that could assist the state's citizens in using solar energy, these three entities joined together to launch the Center with sponsorship from the Energy Division of the NC Department of Commerce.

Dedicated on October 17, 1988, in a formal ceremony at the NCSU Solar House, the Center's educational showcase facility, the Center opened up with an aggressive set of programs to serve

professionals and the public. Among other U.S. universities and state agencies, its comprehensive array of outreach and extension services quickly vaulted it to recognition as one of the premiere solar centers in the country.

In the decade since its founding, the Center has grown and developed into an organization with diverse capabilities and services. While serving North Carolinians will always be its first priority, the Center now operates a number of national and international programs. These range from hosting the nation's database of incentives for renewable energy to providing technical assistance to other states for utility interconnection of photovoltaic systems. Internationally, the Center has installed photovoltaic systems on schools in a rural region in Bolivia, the poorest of all South American nations.

NC Solar Center Facilities

McKimmon Center

- onsite space for workshops, seminars, meetings, exhibits and other events

NC Solar House

- showcase of solar technologies

Research Annex

- testing of new technologies

Electric Vehicle Garage & Solar Charging Station

- alternative fuel vehicle demonstration center



McKimmon Center-NC State University Center for Continuing Education located on the NC State University campus.

NC Solar House-Constructed in 1981, built by NC State Engineering Department, showcase facility for education, demonstration and research.

Research Annex-With the advent of a research program, the Center received approval from the University to create a Solar Research Annex, adjacent to the NCSU Solar House, that could be used for research and testing purposes.

Electric Vehicle Garage & Solar Charging Station-the center has received a grant from the NC Department on Environment and Natural Resources, Mobil Source Emissions Section to combined solar charging station, electric vehicle and alternative fuel vehicle demonstration facility next to the NC Solar House.

Programs Areas

- ⌘ NC Solar House
- ⌘ Outreach and Extension
- ⌘ Research and Development
- ⌘ Education and Training
- ⌘ International Programs
- ⌘ Demonstration Solar Technologies
- ⌘ Policy Analysis



NC Solar House - Open to the public six days a week, the Solar House provides tours for numerous professional, civic and educational groups each year. In 1998, more than 20,000 people visited the facility from around the world.

Outreach and Extension - Information is available through a toll-free hot line, publications and videos, web site, solar home tours and exhibits at events and conferences.

Research and Development - Testing and evaluating building-integrated photovoltaic systems catalyzed the development of a research program at the Solar Center in 1995. Testing of the *Power Roof*, a large solar thermal system intended for location on industrial rooftops and to provide process heat,

absorption cooling and electricity.

Education and Training - Since its formation, the Center has concentrated a large portion of its resources on training professionals and providing educational opportunities for decision-makers and the public to learn about solar energy.

International Programs - The Center's first project was to install photovoltaic systems on 15 rural schools in the Alalay region in the Andes Mountains, in Bolivia.

Demonstrating Solar Technology In trying new technologies and showing them to the public, the Center has provided leadership in designing, installing and monitoring a number of systems around the state.

Policy Analysis In the policy arena, the Solar Center has provided analytical, education and information services on the state and national levels.

Policy Analysis

- ⌘ financial incentives for solar and renewable applications
- ⌘ guaranteeing solar access
- ⌘ restructuring of the electric power industry
- ⌘ provided analytical, education and information services on the state and national levels
- ⌘ interconnection of PV to the grid



In North Carolina, the Center has analyzed the potential impacts of electricity restructuring on renewable energy and energy efficiency, under contract to the NC Solar Energy Association, and made recommendations on how renewable energy could be advanced in a competitive electricity marketplace. This work has led to presentations before the NC Utilities Commission, the Study Commission on the Future of Electric Power, and numerous other organizations.

On the state level, the Center has also assisted the NC Department of Revenue in revising the guidelines for the state tax credits and assessing the potential revenue impacts of proposed changes in the credits. And, the Center has conducted research on the steps that will be needed for the state to reach its goal of obtaining 20% of its energy from renewable resources by 2010.

Looking to the Center's Next Decade

- ⌘ Million Solar Roofs Initiative
- ⌘ A New Headquarters
- ⌘ Electricity Restructuring
- ⌘ Reduction of Greenhouse Gas Emissions



Million Solar Roofs Initiative...North Carolina is a new Partner in this national drive to install 1 million solar systems on rooftops by 2010. The Solar Center will be leading this effort, working with communities throughout the state to develop local programs and get installations in place.

A New Headquarters...the Solar Center has outgrown its quarters in the McKimmon Center and must seek shelter for its rapidly expanding programs.

Electricity Restructuring...with wholesale competition in place nationwide and more than 60% of the nation's population living in states that have decided let consumers choose their electricity providers, retail competition in North Carolina could occur within the next several years. Such an event could open the door to the generation of electricity from renewable resources and, if North Carolina follows the lead of a number of other states, could result in the creation of a Public Benefits Fund or Renewable Portfolio Standard to accelerate the development of renewable energy in our state.

Reduction of Greenhouse Gas Emissions...the Kyoto Treaty on Climate Change calls the industrialized nations to reduce their greenhouse gas emissions by 7% below the nation's 1990 levels by 2008. Already, the U.S. is 7% above this number and still climbing. If the U.S. ratifies the Kyoto Treaty or chooses to tackle global warming with a major reduction in these emissions, then renewable energy will be called upon to provide increasingly larger shares of our state's energy needs.

North Carolina Incentives

- ⚡ Tax Credits 1977
- ⚡ Tax Credits 1994
- ⚡ Tax Credits 2000



The North Carolina General Assembly originally passed solar and renewable energy tax credits in 1977, spurred by the need to support indigenous energy sources as a result of the Oil crises of the 1970's. North Carolina joined many other states and the Federal government in making tax incentives for solar available.

Tax Credits 1977

- ⚡ passed solar and renewable energy tax credits in 1977
- ⚡ solar hot water, heating and cooling systems
- ⚡ for both active and passive systems
- ⚡ 25% of the installation and equipment cost,
- ⚡ up to a maximum credit of \$1,000.



A tax credit was established for installing solar hot water, heating and cooling systems in any building in North Carolina. The credit was for both active and passive systems. The credit limit was 25% of the installation and equipment cost, up to a maximum credit of \$1,000.

Tax Credits 1977 Motivation

- ⚡ support indigenous energy sources
- ⚡ results of Oil crises of the 1970's
- ⚡ economic development
- ⚡ Carter Initiatives



Tax incentives were used for the purpose of economic development by luring renewable energy industry to the state to build product for the renewable energy sector with existing industry.

The Carter Initiatives were the moral equivalency of war. "Energy will be the immediate test of our ability to unite this nation," Carter said. "It can also be the standard around which we rally. On the battlefield of energy we can win for our nation a new confidence and we can seize control again for our common destiny."

Tax Credits 1994

- 40% for solar energy systems on residential buildings, \$1,500 limit.
- 35% for commercial and industrial solar process heat equipment and solar electric systems, \$25,000 Limit.
- 25% credit for the construction of photovoltaic equipment manufacturing facilities, no limit.
- Special valuation of solar energy equipment for property tax purposes



Solar systems on residential buildings The most frequently used solar tax provision was the 40% credit for residential buildings. This credit was for 40% of the cost of the system up to \$1,500 and is applicable to both the personal and corporate income taxes.

Commercial and Industrial Tax Credit A business could claim a 35% credit up to a maximum of \$25,000 for the cost associated with the installation and equipment for active, passive or solar electric systems. This credit provided significant savings for a business looking to implement a solar application.

PV Manufacturers Credit In addition to the 35% corporate tax credit for solar installations to provide

heat or electricity, North Carolina offered a corporate income tax credit to manufacturers of photovoltaic systems. The credit was equal to 25% of the construction and equipment costs of a photovoltaic manufacturing facility. There was no maximum limit to the credit.

Special Valuation for Property Taxes This property tax exclusion allows for active solar heating and cooling systems to be assessed at not more than the value of a conventional heating or cooling system for the purposes of property taxation. This applies only to active solar systems and does not include any land or structural elements of buildings such as walls and roofs. Specifically, a “system” includes all controls, tanks, pumps, heat exchangers and other equipment used directly and exclusively for the conversion of solar energy for heating or cooling. Residential, commercial, and industrial property is eligible for this exclusion.

Tax Credits 1994 Motivation

- great way to bring down the initial cost
- solar energy is such a valuable resource
- enhance the environment
- only indigenous resources
- businesses involved in solar energy



The tax credits are a great way to bring down the initial cost of a solar energy system for your home or business. This is important in North Carolina where solar energy is such a valuable resource. Not only does solar energy enhance the environment by reducing emissions associated with electricity generation, but using solar energy and other renewable resources is taking advantage of North Carolina’s only indigenous resources – while there is no coal or natural gas found in North Carolina, renewable energy resources are abundant. It is also important for the state to support solar energy because there are many North Carolina businesses involved in solar energy.

Tax Credits 2000

Newly Expanded Solar
and
Renewable Tax Credits
in the
State of North Carolina



To simplify and modernize the North Carolina tax credits for solar and other renewable energy sources, new legislation was enacted in the 1999 legislative session.

Simplification and Modernization of Solar and Renewable Tax Credits

- Number of credits were reduced
- 35% for all technologies
- Limits established on credits based on energy source and sector served
- Credits expanded to cover more renewable technologies



Fourteen different credits were eliminated and replaced by one general credit that covered residential and non-residential solar and other renewable energy property. A credit of 35% was established for all renewable energy sources, with the maximum limits varying by renewable energy resource or technology, and by residential or non-residential sectors.

Tax Credits 2000 Motivation

- increasing environmental concerns
- sustainability
- continued support of solar industry



The motivations that drove the continuation of the credits in 1994 are still the same in 2000, but with a growing increase in the concerns for the environment and sustainability of industry and the economy.

The solar and renewable industries continue to grow in the state with the aid of the renewable tax credits. These credits are essential to help build the infrastructure the industry needs to become sustainable.

Fourteen different credits were eliminated and replaced by one general credit that covered residential and non-residential solar and other renewable energy property

- Residential active, passive solar thermal and solar electric were 40% to \$1500
- Commercial active, passive solar thermal and solar electric were 35% to \$25,000
- Hydro 10% to \$5,000
- Wind 10% to \$1,000

Number of credits were reduced

- Fourteen different credits were eliminated
- Replaced by one credit for residential and non-residential
- Credit covering solar and renewable energy property



35% for all technologies

- Previous credits varied from 10% to 40%
- To simplify credit all were set to 35%



- Biomass: 35%, limit \$10,500 Per Installation
- Hydroelectric: 35%, limit \$10,500 Per Installation
- Solar Energy Equipment for Domestic Water Heating: 35%, limit \$1,400 Per Dwelling Unit
- Solar Energy Equipment for Active Space Heating: 35%, limit \$3,500 Per Dwelling Unit
- Solar Energy Equipment for Combined Active Space and Domestic Hot Water Systems: 35%, limit \$3,500 Per Dwelling Unit
- Solar Energy Equipment for Passive Space Heating: 35%, limit \$3,500 Per Dwelling Unit
- Solar Energy (Systems not covered by the \$1,400 and \$3,500 credit): 35%, limit \$10,500 Per Installation
- Wind: 35%, limit \$10,500 Per Installation

Credit Limits Residential

- ⌘ \$1,400 residential solar domestic hot water
- ⌘ \$3,500 residential active space heating, combined solar hot water and space heating passive space heating
- ⌘ \$10,500 residential biomass, hydroelectric and photovoltaic or solar thermal electric

- Biomass: 35% to \$250,000 Per Installation
- Hydroelectric: 35% to \$250,000 Per Installation
- Solar Energy Equipment for Domestic Water Heating: 35% to \$250,000 Per Installation
- Solar Energy Equipment for Active Space Heating: 35% to \$250,000 Per Installation
- Solar Energy Equipment for Combined Active Space and Domestic Hot Water Systems: 35% to \$250,000 Per Installation
- Solar Energy Equipment for Daylighting: 35% to \$250,000 Per Installation
- Solar Energy Equipment for Solar Electric or Other Solar Thermal Applications: 35% to \$250,000 Per Installation
- Wind: 35% to \$250,000 Per Installation

Credit Limits Non-residential

- ⌘ \$250,000 all technologies

More renewable technologies are now included.

Biomass: 100% of the cost of biomass equipment that uses renewable biomass resources for biofuel production of ethanol, methanol, and biodiesel; anaerobic biogas production of methane utilizing agricultural and animal waste or garbage; or commercial thermal or electrical generation from renewable energy crops or wood waste materials. The term also includes related devices for converting, conditioning, and storing the liquid fuels, gas, and electricity produced with biomass equipment, including installation cost.

Hydro: 100% of the cost of equipment to generate electricity at an existing dam or free-flowing waterway, including related devices to convert, condition or store the electricity, including installation cost.

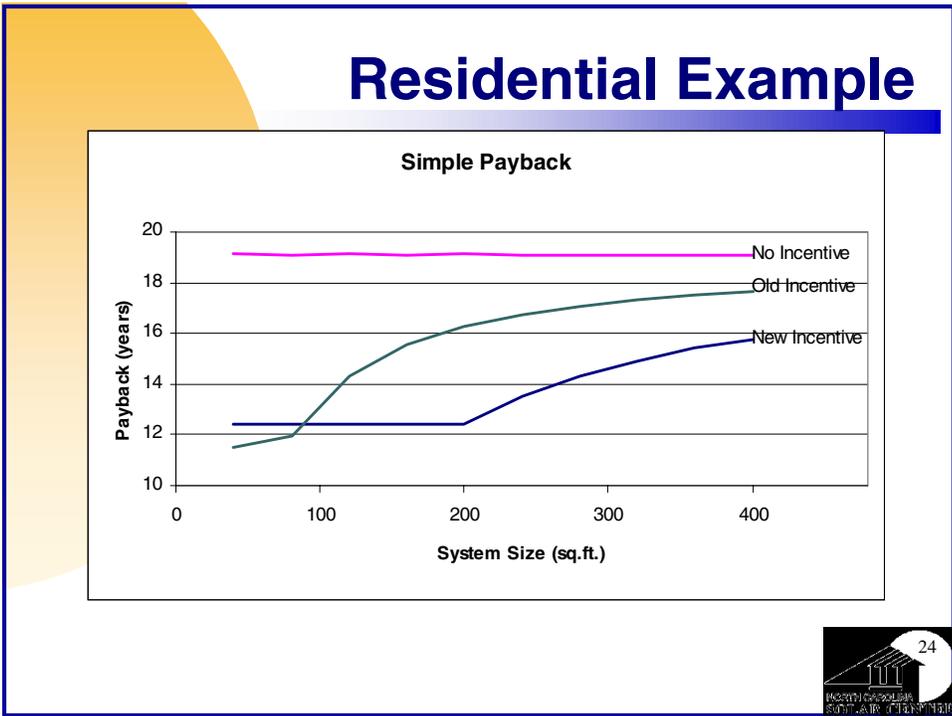
Wind: 100% of the cost of equipment to generate electricity or mechanical power from wind energy, including related devices for converting, conditioning, and storing the electricity produced, including installation cost.

Solar: 100% of the cost of collectors, storage, controls and heat exchangers used for solar system only, including installation cost.

Credits expanded to cover more renewable technologies

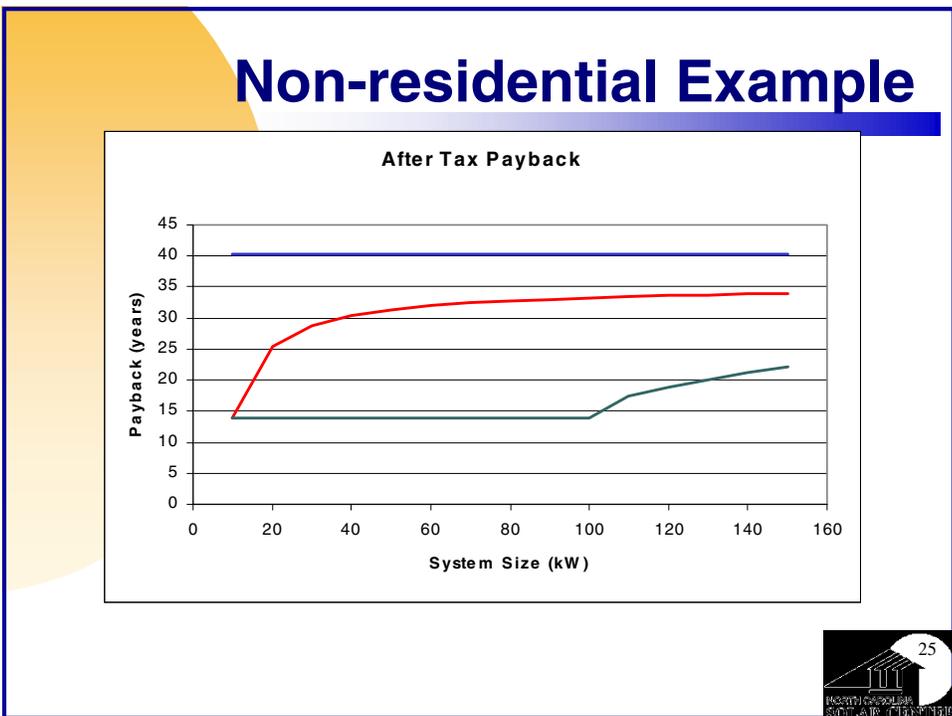
- ⌘ Biomass
- ⌘ Hydro
- ⌘ Wind
- ⌘ Solar
- ⌘ Daylighting

Daylighting: 100% of the cost of lighting controls, vertical roof monitors, baffles, lightshelves, lightshelf glazing, advanced daylighting glazing, roof monitor glazing and daylighting transport systems, including installation cost.



Residential Example

The effect on the simple payback by the changes in the tax incentives is shown for solar energy equipment used for active space heating, calculated at an estimated cost of \$50 per square foot, used to replace electric resistance heating. The simple paybacks on systems with collector areas from 40 square feet to 400 square feet were compared with no tax incentives, the old tax incentive of 40% (with a \$1,500 limit), and the new tax incentive of 35% (with a \$3,500 limit).



Industrial and Commercial Example

This graph shows the effect on the simple payback by the changes in the tax incentives if solar energy equipment, at an estimated cost of \$7 per watt, is used to produce electricity to replace electricity from the grid. The after tax paybacks on systems with collector areas from 10 kW to 150 kW were compared with no tax incentives, the old tax incentive of 35% (with a \$25,000 limit), and the new tax incentive of 35% with a \$250,000 limit.

The after tax payback in the graph also takes into account the 10% Federal tax credit and 5 year accelerated depreciation.