

**Explore More: The Future of Energy****Script**

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|  | <p>CLOCKS AND COMPUTERS.</p> <p>REFRIGERATORS AND RADIOS.</p> <p>TELEPHONES, TOYS, AND TOASTERS. BIG LIGHTS, SMALL LIGHTS, BRIGHT LIGHTS, LITE-BRITES.</p> <p>BLOW DRYERS, CLOTHES DRYERS, CURLING IRONS AND CLOTHING IRONS. FANS, AND FASTFOOD, PLANES, TRAINS AND AUTOMOBILES. WHAT DO THEY ALL HAVE IN COMMON? THEY CAN T COMPUTE OR COOL OR RING OR LIGHT OR DRY OR COOK OR FLY OR DRIVE WITHOUT ENERGY. FROM THE SMALLEST APPLIANCES TO THE BIGGEST BUSINESSES, ENERGY, ESPECIALLY ELECTRICITY, FUELS OUR ECONOMY AND OUR LIFESTYLES. (Kevin Waetke/Midamerican Energy: "Across the board, people are using more electricity than they ve ever used in their life. They have multiple computers in their home. They have hot tubs. They plug in their car at night. There s a lot of electricity demand." )</p> <p>AND THAT DEMAND IS GROWING.</p> <p>CONSIDER YOUR OWN CONSUMPTION,</p> |
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|  | <p>HOW MANY THINGS DO YOU DO IN A DAY THAT DEMAND ENERGY? (kidcam answers)</p> <p>NOW, DO YOU THINK YOU COULD YOU GO EVEN ONE DAY UNPLUGGED ? O.K.</p> <p>MAYBE YOU COULD BUT IMAGINE DOING BUSINESS WITH NO CASH REGISTERS OR COMPUTERS, NO FAXES, OR PHONES, OR LIGHTS. MAKES A TRIP TO THE MALL PRETTY POINTLESS! THE POINT IS, WE DEPEND ON ELECTRICITY TO POWER EVERY ASPECT OF OUR LIVES. AS WE RACE TOWARD THE FUTURE, DEVELOPING COUNTRIES MAY MOVE INTO THE FAST LANE ELECTRICITY PROVIDES THE UNITED STATES. ("I think if you re going to look at the future of energy, it s impossible to look at the U.S. standing alone in isolation. Given the world, the growth in population the growth in economic per capita income in the world, people want to live like we live, and rightly so. When you take that out to 2050 you suddenly have 9-10 billion people on the planet all using large amounts of energy.")</p> <p>THAT S A LOT OF DEMAND! SO HOW DO WE MAKE SURE THERE WILL BE ENOUGH POWER TO GO AROUND?</p> |
|  | <p>THIS IS THE TRANSMISSION ROOM AT MIDAMERICAN ENERGY, ONE OF HUNDREDS OF POWER COMPANIES TRYING</p>  |

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|  | <p>TO ANSWER THE QUESTION HOW WILL WE POWER THE FUTURE? IT S THE FOCUS OF DEBATE IN THE UNITED STATES, AND ACROSS THE GLOBE, AS COUNTRIES STRUGGLE TO BALANCE ENERGY DEMAND AGAINST SKYROCKETING COSTS AND SERIOUS ENVIRONMENTAL CONCERNS. SINCE THE FUTURE OF ENERGY IS REALLY EVERYONE S FUTURE, LET S EXPLORE MORE ABOUT ENERGY, SPECIFICALLY ELECTRICITY. WE LL LOOK AT HOW IT S GENERATED, THE DIFFERENT RESOURCES TO DO THE JOB, AND THEIR ENVIRONMENTAL OUTCOMES. WE LL LOOK AT WAYS WE CAN ENSURE OUR ENERGY FUTURE, BY CREATING GREATER SUPPLY, AS WELL AS CUTTING OUR CONSUMPTION. AND WE LL SEE HOW EXCITING NEW TECHNOLOGIES COULD CHANGE THE WAY WE THINK ABOUT ELECTRICITY. SO LET S PLUG IN, POWER UP, AND EXPLORE MORE ABOUT THE FUTURE OF ENERGY.</p> |
|  | <p>LET S START WITH SOME BASICS ABOUT ELECTRICITY...</p> <p>(Brent: "There are really several steps in producing and distributing electricity. You start really with the fuel source, and electricity s really very versatile. It can use virtually any fuel. So you convert that fuel</p>   |

**Generation, Transmission, Distribution**

into electricity. You send it through these large transmission lines. You step down the voltage to a distribution level and then you distribute it to businesses homes, malls, shopping centers and the like.") 3 SIMPLE STEPS. GENERATION, TRANSMISSION, AND DISTRIBUTION. FIRST STEP, GENERATION. THE PROCESS OF GENERATING THE ACTUAL ELECTRICITY IS PRETTY MUCH THE SAME FROM POWER PLANT TO POWER PLANT. WHAT'S DIFFERENT IS THE ENERGY SOURCE THAT'S USED. HERE'S HOW IT WORKS. AN ENERGY SOURCE IS USED TO TURN A TURBINE. THE TURBINE SPINS A GENERATOR. THE SPINNING GENERATOR PRODUCES ELECTRICITY. THE INITIAL ENERGY SOURCE CAN BE ANYTHING FROM COAL BURNED TO HEAT WATER INTO STEAM TO TURN THE TURBINE, TO NUCLEAR FISSION, WIND, WATER, EVEN WASTE. THAT'S GENERATION. THE SECOND STEP IS TRANSMISSION. ELECTRICITY IS TRANSMITTED OVER A HUGE NETWORK OF HIGH-VOLTAGE LINES CALLED THE GRID. THESE LINES CRISSCROSS OUR COUNTRY, TAKING THE POWER FROM THE PLANTS WHERE IT'S PRODUCED, TO THE POINTS WHERE IT'S USED. NEXT TIME YOU'RE OUT

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|  | <p>DRIVING AROUND, CHECK OUT TRANSMISSION LINES. THEY'RE NEXT TO ROADS, OVER RIVERS, UP ON HILLS AND DOWN IN VALLEYS. TRANSMISSION LINES ARE THE LONG-DISTANCE LEG OF POWER'S TRIP FROM THE PLANT, TO PEOPLE. THE LAST STEP IS DISTRIBUTION. SUBSTATIONS AND TRANSFORMERS STEP THE POWER DOWN FROM THE HIGH-VOLTAGES USED TO TRANSMIT IT OVER THOSE LONG DISTANCES, TO LOWER USEABLE LEVELS. THEN IT'S DISTRIBUTED OVER LOWER VOLTAGE LINES INTO HOMES AND BUSINESSES.</p>   |
| <p>(Brent: "That's part of the answer, to convert fuel much more efficiently, to transport it much more efficiently and to use it much more efficiently. Efficiency is the key. Efficiency is the key to the future.")</p> | <p>SO THOSE THREE STEPS, GENERATION TRANSMISSION AND DISTRIBUTION PROVIDE OUR POWER. TO POWER THE NEEDS OF THE FUTURE, EACH STEP WILL REQUIRE CHANGE; MAKING THE ENTIRE PROCESS MORE EFFICIENT. EXPERTS AT THE ELECTRIC POWER RESEARCH INSTITUTE, A LEADING INDUSTRY THINKTANK BELIEVE THE MOST PRESSING NEED FOR CHANGE IS IN THE VERY FIRST STEP, GENERATION. (Brent: "Given our current technology and given the growth in our world, we're on a collision course with the environment.") WHAT PUT US ON THAT PATH?</p> |

**ELECTRICAL SCHEMATIC TRANSITION**

MANY EXPERTS BELIEVE IT S OUR RELIANCE ON FOSSIL FUELS FOR TRANSPORTATION, AND FOR ELECTRIC POWER GENERATION.

(Tony: "The energy mix in the U.S. at the moment is very heavily weighted towards fossil fuels. For electricity, about 50% of our raw fuel, the raw energy for it comes from coal, about another 20% is natural gas. So it adds up very quickly that it s very overwhelmingly fossil fuels.")

THE REASON GAS AND COAL ARE RELIED ON SO HEAVILY IS SIMPLE ECONOMICS, SUPPLY AND DEMAND. ( Tony: "Have lots of coal, hundreds of years worth.") AND ALL THAT SUPPLY MEANS SAVINGS FOR CONSUMERS.

(Kevin: "Probably the biggest benefit we have by producing coal-fired electricity is that coal is abundant, which means the fuel source is cost effective. And that means lower rates for customers in the long run.").

EVEN THOUGH FOSSIL FUELS ARE ABUNDANT AND COST-EFFECTIVE, THERE IS A PRICE TO PAY.

GLOBAL CLIMATE CHANGE, SMOG, ACID RAIN, THESE VERY SERIOUS

ENVIRONMENTAL PROBLEMS ALL GET TRACED BACK TO BURNING FOSSIL FUELS.

(Tony: "It s very clear that the carbon that s contained in these fossil fuels has contributed to the

About 2/3 of all SO<sub>2</sub> (sulfur) and 1/4 of all NO<sub>x</sub> comes from electric power generation that relies on burning fossil fuels like coal.

increase in the concentration of CO<sub>2</sub> in the atmosphere. You know, it's a measurable significant increase. Most people think about global climate change these days, but probably the more immediate problems really have to do with acid rain that's formed from sulfur that's in the fossil fuels that we use). ACCORDING TO THE ENVIRONMENTAL PROTECTION AGENCY, ABOUT 2/3 OF ALL SULFUR EMISSIONS COME FROM ELECTRIC POWER GENERATION. ONE WAY TO LOWER FOSSIL FUELS ENVIRONMENTAL PRICE TAG IS THROUGH TECHNOLOGY. (Tony [talking about clean coal]: "Underground coal gasification (ucg) is an emerging technology, which is showing increasing promise as a means of utilizing vast coal reserves which are unrecoverable by conventional techniques. The METC program has concentrated on the design and construction of linked vertical well.'')

DEVELOPING THESE CLEANER-BURNING TECHNOLOGIES COULD KEEP FOSSIL FUELS IN THE ENERGY MIX FOR THE FUTURE, BUT EPRI FORESEES A TREND *AWAY* FROM FOSSIL FUELS. ("We need to basically accelerate the move away from fossil fuels. It's happening. What's interesting is over the last 150 years the global energy system has been decarbonating reducing its carbon. Progressively

as we've moved from wood with a lot of carbon very little hydrogen, to coal which has many more hydrogens to carbons, to oil to gas and now into renewables and nuclear power, which are essentially free of carbon dioxide. So we're about halfway through about a 300 year trend of decarbonizing the whole energy system. So we're moving in the right direction, but we may not be moving fast enough.)

REMEMBER THAT COLLISION COURSE WITH THE ENVIRONMENT? OF COURSE THERE ARE OTHER OPTIONS FOR GENERATING ELECTRICITY. (Brent: "Electricity allows you to diversify fuels. That's one of the advantages of electricity. You can take advantage of the sun. You can take advantage of the wind. You can take advantage of the splitting of atoms, nuclear power...You can take advantage of geothermal energy coming up from the center of the earth. So it allows you to diversify energy and that's really where energy is going into a very diversified portfolio of sources.") THESE DIVERSE SOURCES ALL HAVE BENEFITS AND DRAWBACKS, JUST LIKE FOSSIL FUELS. AS WE LOOK AT THE OTHER OPTIONS TO GENERATE ELECTRICITY, KEEP SOME QUESTIONS IN MIND. IS THE RESOURCE ABUNDANT? IS IT AVAILABLE? IS IT COST-EFFECTIVE? AND WHAT ARE THE

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|  | <p>ENVIRONMENTAL OUTCOMES OF USING THE ENERGY SOURCE? OKAY, LET S EXPLORE MORE ABOUT THE FUTURE OF ENERGY.</p>   |
|  | <p>NUCLEAR ENERGY CURRENTLY PROVIDES A LITTLE MORE THAN 20% OF THE ELECTRIC POWER IN THE U.S. INDUSTRY EXPERTS PREDICT THAT NUMBER WILL GROW, DESPITE SERIOUS DRAWBACKS LIKE THE THREAT OF NUCLEAR MELTDOWNS AND THE STORAGE OF RADIOACTIVE WASTE. ("Nuclear fuel is cheaper than any other kind of fuel that we use for large-scale generation in this country, and its cheaper than any fuel that we can conceive of at this time. Environmentally, the huge advantage that nuclear offers the country or the world for that matter is it produces no air emissions and in particular no greenhouse gases." ) AND URANIUM, THE RAW RESOURCE USED TO PRODUCE NUCLEAR POWER, IS RELATIVELY ABUNDANT. SO IT S CHEAP, ABUNDANT, AND DOESN T CONTRIBUTE GREENHOUSE GASES. SAFETY CONCERNS THEN, ARE REALLY THE MOST SERIOUS THREAT TO THE FUTURE GROWTH OF NUCLEAR POWER. WITH IMAGES OF NUCLEAR ACCIDENTS AT CHERNOBYL AND</p> |

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|                     | <p>3-MILE ISLAND PLANTED IN THE PUBLIC'S MIND, THE INDUSTRY MUST CONVINCED PEOPLE THAT NUCLEAR POWER IS <i>SAFE AS WELL AS CLEAN</i>. FUTURE GENERATIONS OF NUCLEAR REACTORS COULD HELP ALLEVIATE CONCERNS. ("As we look at the new designs in the future, they're going to be simpler and safer. More reliable and more competitive so we can get the environmental benefits of no emissions at a better price.") NEW REACTORS COULD ELIMINATE THE THREAT OF A MELTDOWN, BUT THEY DON'T SOLVE THE PROBLEM OF RADIOACTIVE NUCLEAR WASTE. ("What will we do with the waste? We won't bury it and leave it there for 250,000 years. My guess is that within a hundred years we'll have the technology to dispose of that in very safe ways.")</p> <p>SO WHAT'S YOUR REACTION TO NUCLEAR POWER AS A RESOURCE FOR THE FUTURE?</p> |
|                     | <p>A LOT OF HOPE FOR THE FUTURE RIDES ON RENEWABLES, A WHOLE CLASS OF FUELS THAT WON'T RUN OUT, <i>AND</i> HAVE A SQUEAKY CLEAN ENVIRONMENTAL REPUTATION.</p>   |
| <p><b>SOLAR</b></p> | <p>LET'S START WITH A REDHOT RENEWABLE: SOLAR POWER. JUST AS PLANTS CONVERT SUNLIGHT INTO ENERGY TO GROW,</p>   |

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|  | <p>SUNLIGHT CAN ALSO BE CONVERTED INTO ELECTRICITY. INSTEAD OF USING A GENERATOR TO PRODUCE THE POWER, SPECIAL CONVERTORS CALLED PHOTOVOLTAIC CELLS CHANGE THE SUN S RAW ENERGY INTO USEABLE ELECTRICITY. COMPANIES LIKE THINFILM TECHNOLOGIES IN IOWA ARE ON THE CUTTING EDGE OF SOLAR CELL MANUFACTURING, MAKING THEM MORE POWER EFFICIENT AND MORE COST EFFECTIVE. COMPANY FOUNDER FRANK JEFFREY SLOWED DOWN LONG ENOUGH TO TALK ABOUT SOME OF THE COOL WAYS THEIR CELLS CAN BE USED. (Frank: "Actually, there s an expedition going up Mt. Everest that has some of our modules for power, mostly for charging the battery packs for video cameras that are going on the expedition. So there are a lot of portable type applications. Long-term what we re shooting for is an integrated building market, where the photo cells are mounted into the building panels themselves. So that instead of putting just a painted or a plastic coated panel up for the roof of a building, you would put up a panel that would have a solar module as a part of it.") THAT FUTURE IS NOW FOR MIKE KAPPUS, WHO RUNS A MUSIC AGENCY IN SAN FRANCISCO. HIS PANELS</p> |
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|  | <p>AREN T MOUNTED <b>IN</b> THE ROOF, BUT <b>ON</b> THE ROOF. (Mike: "We've got 96 panels here, which is actually, when it was installed, it was the largest solar installation in San Francisco. It provides all of our energy needs and then some during the day. We don't have storage for electricity here. We don't have batteries that we store up so we do draw off the grid during the night, but the net result is that overall we are generating more electricity over the course of a year than we're using. So we're actually supplying a surplus back into the grid for California.") WHICH IS WHY, IF YOU LOOK CLOSELY, YOU SEE THEIR METER IS ACTUALLY RUNNING BACKWARDS! ASK KAPPUS WHY SOLAR AND YOU LL GET A PASSIONATE PITCH FOR THIS RENEWABLE. ("Somebody asked me why go with solar and I said why not go with solar. Solar energy is created during the daytime only, but that's the greatest time of need for electricity. So you're creating the electricity at the time its most needed. At nighttime it's not needed as much so you cannot have to build a new power plant to provide the peak periods of time because the solar is taking care of the peak periods of time. We can avoid the production of power plants. We can avoid the drilling of Alaska or off our coastline. Knowing that you can create your own energy with no pollution</p> |
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|                    | <p>whatsoever for an indefinite period of time. You continue to produce and produce and produce electricity with no harmful effects. I wanted to do that. It's just our planet, the air we breathe and the water we drink. Otherwise there's no particular reason." ) WHILE SUNLIGHT ITSELF IS FREE, THERE IS A COST ASSOCIATED WITH SOLAR POWER. PURCHASING THE PV-CELL SYSTEMS CAN BE QUITE EXPENSIVE. ESPECIALLY ON A SCALE LARGE ENOUGH TO PRODUCE SIGNIFICANT AMOUNTS OF ELECTRICITY. BUT DESIGN IMPROVEMENTS AND INCREASED MANUFACTURING COULD BRING THOSE COSTS DOWN. CURRENTLY, SOLAR POWER ACCOUNTS FOR LESS THAN 1% OF ALL THE ELECTRICITY GENERATED IN THE UNITED STATES, A NUMBER JEFFREY, KAPPUS, AND MANY OTHERS HOPE WILL INCREASE. SHOULD THE SUN GET A STARRING ROLE IN OUR ENERGY FUTURE?</p> |
| <p><b>WIND</b></p> | <p>A RENEWABLE RAPIDLY INCREASING ITS WORLDWIDE PIECE OF THE ENERGY PIE IS WIND. WINDPOWER HAS THE <i>POTENTIAL</i> TO PROVIDE THREE TIMES THE AMOUNT OF ELECTRICITY THE UNITED STATES CONSUMES. <i>CURRENTLY</i>, IT PROVIDES LESS THAN 1% OF ALL THE ELECTRICITY IN THE</p>   |

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|  | <p>U.S. MORE AND MORE POWER COMPANIES<br/>THOUGH, ARE LOOKING TO HARVEST THIS<br/>ENERGY CROP. WINDPOWER CONSULTANT<br/>TOM WIND EVALUATED THE RESOURCE<br/>FROM THE LARGEST WINDFARM IN THE<br/>WORLD NEAR STORM LAKE, IOWA. (Tom:<br/>"The main benefit of wind generation is that it s<br/>pollution free. There are no greenhouse gases, such<br/>as CO2. No nitrogen oxides or sulfur dioxides. No<br/>acid rain or smog precursors. No air emissions.<br/>That s the primary benefit.") (There are some limits<br/>to the use of wind power, and the biggest issue is<br/>intermittency. It s the fact that the wind doesn t<br/>always blow at a steady rate. Sometimes it just<br/>doesn t blow. When that happens, they don t<br/>generate any power so you have to rely on other<br/>generators that can be controlled such as coal fired<br/>plants or gas-fired combustion turbines.") JUST<br/>HOW MUCH POWER CAN THESE GIANTS<br/>GENERATE? ("Here on this site, one wind turbine<br/>here will generate enough power to supply four fast<br/>food restaurants, such as Burger King or<br/>McDonalds or Hardees...one wind turbine will<br/>supply enough energy for them for the whole year.<br/>So one wind turbine running for one year is enough<br/>to supply four fastfood outlets for a year.")<br/>OF COURSE THIS WINDFARM CAN HARVEST<br/>ALL THAT POWER BECAUSE ITS LOCATED</p> |
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|                             | <p>IN ONE OF THE WINDIEST REGIONS IN AMERICA. NOT EVERYPLACE HAS SUCH BOUNTIFUL RESOURCES TO TAP INTO. AND EVEN IF THE RESOURCE IS THERE, NOT EVERYONE WANTS TURBINES SITED NEAR THEM, MAINLY BECAUSE OF LOOKS. SO WHAT S THE FUTURE FOR WIND TURBINES? ("They re getting larger. They re becoming lower cost per Kw hour that s generated. The fact they re getting the higher wind speed, it s going to decrease the cost. And that s the main technological improvement we re expecting to see.") WILL WINDPOWER CONTINUE TO WHIP UP SUPPORT FOR THE FUTURE?</p>   |
| <p><b>HYDROELECTRIC</b></p> | <p>WATER IS ANOTHER IMPORTANT ELEMENT UTILIZED TO CREATE ELECTRICITY. HYDROPOWER CREATES NEARLY 10% OF ALL OUR ELECTRICITY. IT S ONE OF THE OLDEST FORMS OF ELECTRIC POWER GENERATION, AND WHILE IT S WELL-ESTABLISHED, THERE IS ROOM TO GROW. ("There s a lot of potential for hydropower out there yet to be produced in the U.S. We could probably double the amount of hydropower. Worldwide there are many resources especially in developing countries. A lot of those are in mountainous terrain with heavy rainfalls, where there s great potential for building reservoirs.") WHAT ARE WATER S</p> |

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|                       | <p>STRENGTHS AND WEAKNESSES WHEN IT COMES TO PRODUCING POWER? ("As you can see in the plant behind me, there are no emissions. There s no smoke, no particulate, no greenhouse gases and as long as it keeps on raining, it s going to be a renewable source. Hydropower has an economic advantage in that it is relatively cheap to produce. Of course we have no fuel to purchase like a coal-fired plant, which must purchase and transport its fuel. It s also flexible. It can be started quickly and the load can be changed very quickly.")</p> <p>("A big disadvantage to building a hydroelectric plant is its initial cost. It s very capital intensive, which means it takes a lot of money upfront to build the facility. In addition, environmentally it can take up a lot of land. If we re forming a reservoir behind the dam, it can flood a lot of acres. It can also change the local ecology. For example, if we dam up a fast moving river, it becomes a pond, so that changes the type of aquatic life that lives there." )</p> <p>WILL HYDROPOWER MAKE AN EVEN BIGGER SPLASH IN THE FUTURE?</p> |
| <p><b>BIOMASS</b></p> | <p>ANOTHER RENEWABLE RESOURCE TURNS TRASH INTO TREASURE. BIOMASS IS ANYTHING FROM LEFTOVER CROPS AND WEEDS, TO GARBAGE, EVEN MANURE, ALL OF WHICH CAN BE TURNED INTO POWER. SURROUNDED BY ACRES OF IOWA CORN IS</p>   |

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|                          | <p>BECON, A RESEARCH FACILITY FINDING WAYS TO REUSE AMERICA S LEFTOVERS.</p> <p>(Norm Olson: "We re talking about wood chips or switchgrass or cornstalks, actually the corn kernel itself, any plant material out there. We basically try and convert those into different forms of energy.</p> <p>There s no one process. We have probably six or seven types of processes we can use out here. Right now we can make electricity fairly low cost with methane. The anaerobic digestion process that we use over here where the bacteria converts the waste materials. So if we re starting with waste materials like hog manure and out-of-condition hay and things that are kind of waste products right now. We can make that work pretty well in terms of cost. But if you want to do it in a big way you really have to have the cost of coal go up.") MUCH OF THE BIOMASS EFFORT AT BECON IS EXPERIMENTAL, BUT THERE ARE POWER PLANTS IN OPERATION USING BIOMASS IN COMBINATION WITH COAL, OR EVEN AS THEIR MAIN FUEL SOURCE, CREATING A LITTLE LESS THAN 1 % OF ALL OUR ELECTRICITY. HOW BIG A PLAYER WILL BIOMASS BE IN THE FUTURE OF ENERGY?</p> |
| <p><b>GEOTHERMAL</b></p> | <p>PULLING POWER FROM DEEP INSIDE THE EARTH IS ANOTHER OPTION. GEOTHERMAL POWER TAPS INTO THE HEAT OF THE</p>   |

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|  | <p>EARTH'S CORE TO CREATE ELECTRICITY.</p> <p>THERE ARE ONLY A FEW PLACES IN THE WORLD THAT CAN TAKE ADVANTAGE OF THIS RESOURCE TO PRODUCE ELECTRICITY ECONOMICALLY, ONE OF THEM IS THE GEYSERS, NORTH OF NAPA VALLEY CALIFORNIA. ("The Geysers geothermal area is the largest in the entire world. It's 30 square miles with 21 power plants, 19 of which are owned by Calpine Corporation. Between all 21 plants, we create 1000 MW of energy. The 1000 MW that we produce at the Geysers is enough for 1 million homes. ) LIKE OIL WELLS, GEOTHERMAL WELLS DRILL DOWN INTO THE EARTH TO RECOVER THE ENERGY RESOURCE.</p> <p>INSTEAD OF OIL, IT'S STEAM THEY'RE AFTER, STEAM TO TURN TURBINES TO PRODUCE POWER. ("The biggest benefit of geothermal, besides the fact that it's a renewable resource that mother nature creates for us, is we're saving millions of barrels of fossil fuels every year. With the 850 MW that we make here at the Geysers, We're saving 8 million barrels of oil every year from being burned...As far as the costs of utilizing geothermal energy, most of them are in the initial phases. Drilling the actual wells...it's 2-3 million dollars. It's hundreds of millions of dollars to build a power plant, but luckily we have all those</p> |
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|  | <p>resources set up right now.") GEOTHERMAL IS SO REGIONALLY SPECIFIC IT CONTRIBUTES ONLY A SMALL PERCENTAGE OF ALL OUR ELECTRICITY IN THE U.S., JUST UNDER 1%. WILL GEOTHERMAL POWER BE A HOT RESOURCE FOR THE FUTURE?</p>  |
|  | <p>THE FINAL ALTERNATIVE WE LL EXPLORE MORE ABOUT HAS A LOT OF HIGH HOPES PINNED TO IT, HYDROGEN. MANY EXPERTS LOOK TO HYDROGEN AS THE PERFECT ENERGY SOLUTION, THE ULTIMATE CLEAN RENEWABLE RESOURCE. (Brent: Hydrogen has been the Holy Grail of energy. For fifty years people have been talking about it, and that s where we re going to end up. But the infrastructure for creating, generating, storing, transporting hydrogen doesn t exist. It s going to be a horrendous job to do it. Nobody knows quite how to do it yet, but the goal is so great, the payoff is so tremendous that it will happen.) HERE S HOW HYDROGEN FUELED ELECTRICAL GENERATION COULD WORK. HYDROGEN IS THE MOST ABUNDANT ELEMENT IN THE UNIVERSE. BUT, IT DOESN T EXIST BY ITSELF, IT S ALWAYS IN COMBINATION WITH OTHER ELEMENTS. SO HYDROGEN HAS TO BE SEPARATED OUT FROM METHANE OR GAS OR PETROLEUM FOR EXAMPLE. ONE</p> |

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|  | <p>PROCESS TO SEPARATE THE HYDROGEN IS HYDROLYSIS. ELECTRICITY IS USED TO SPARK A REACTION IN WATER, H<sub>2</sub>O. THE CURRENT SEPARATES THE Hs THE HYDROGEN MOLECULES FROM THE Os THE OXYGEN MOLECULES. ONCE THE HYDROGEN IS SEPARATED, IT CAN BE FED THROUGH A DEVICE CALLED A FUEL CELL TO GENERATE ELECTRICITY <i>WHENEVER</i> OR <i>WHEREVER</i> ITS NEEDED. THE ONLY BYPRODUCT FROM FUEL CELLS IS PURE WATER. CONSULTANT TOM WIND HYPOTHESIZED HOW A HYDROGEN SYSTEM COULD MAKE THE MOST OF RENEWABLE RESOURCES LIKE WIND.(Tom: "I can see someday in the future there will be literally thousands of wind turbines spread across maybe 50 or 100 miles and there ll be big plants that ll take this electricity and generate hydrogen. Then the hydrogen will be put into underground pipes going to the metropolitan areas such as Chicago and Denver and St. Louis. It ll be used to generate power maybe right at your home using fuel cells. ) SOLAR PANELS COULD ALSO BE PUT TO USE GENERATING ELECTRICITY TO PRODUCE HYDROGEN. IT S LIKE THAT OLD SAYING MAKE HAY WHILE THE SUN SHINES, BUT YOU MAKE HYDROGEN</p> |
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WHEN THE SUN SHINES, OR WHEN THE WIND BLOWS. THE SYSTEM COULD MAKE THE MOST OF RENEWABLES STRONG POINTS, AND AVOID THEIR DOWNFALLS. IOWA SENATOR TOM HARKIN ADVOCATES A SWITCH TO HYDROGEN AS SOON AS POSSIBLE. (Harkin: "The real fuel for our future and I don't mean 100 years from now, I mean now is hydrogen. Hydrogen can be used to produce the energy that we need in a very clean non-polluting manner. We need to start building an infrastructure for hydrogen. I've seen one estimate, that said that in the next ten years, with 100 billion dollars, we could have an infrastructure for hydrogen.")

THAT'S A PRETTY BIG HURDLE TO CLEAR BUT EXCITING EXPERIMENTS ARE ALREADY UNDERWAY USING HYDROGEN AS FUEL FOR ELECTRIC CARS, BUSES, EVEN A WHOLE HOUSE WAS POWERED BY FUEL CELLS AND HYDROGEN IN CHICAGO. WILL FUEL CELL SHAKE UP THE FUTURE OF ENERGY?

(Brent: "The perfect energy system of the future would be hydrogen and electricity. Electricity is completely clean at the point of use. It's extraordinarily precise, enough to run electrons. You can't run a computer on a lump of coal or a gas

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|  | <p>flame, you need something as precise as electricity.</p> <p>Hydrogen would be the ideal source for generating that electricity. That conversion technology is coming along, the using technology s taking place right now. It s how do you get the hydrogen? So that s the hurdle we have to get over in the future.</p> <p>But the hydrogen electricity system is where we ll end up 150-200 years from now. Whether we get there sooner is really the challenge, and I think we need to get there sooner because of the environmental issues." )</p>  |
|  | <p>WHICH BRINGS US BACK TO WHERE WE STARTED, THAT COLLISION COURSE WITH THE ENVIRONMENT. WE VE SEEN THERE ARE LOTS OF OPTIONS TO AVOID THAT CRASH, BUT WHAT S THE <i>BEST</i> RESOURCE TO RELY ON TO GENERATE ELECTRICITY FOR THE FUTURE? ("Sometimes people get sidetracked on a discussion about is it going to be coal, is it going to be natural gas? Is it going to be windmills? Is it going to be solar? Well no. Is it going to be nuclear? Which one is it going to be? That discussion is offtrack because the needs for the future are going to be so large that we re going to need everything. The question is what is the mix then.) WHAT DO YOU THINK? WHAT S THE OPTIMAL ENERGY MIX AND WHY?</p> |
|  | <p><b>KIDS DISCUSS PROS/CONS</b> What would you</p>  |

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|  | <p>include in your mix, why would you include it, how will we move forward what can individuals do</p>  |
|  | <p>IT ISN T JUST THE GENERATION OF ELECTRICITY THAT WILL CHANGE, TRANSMISSION AND DISTRIBUTION HAVE CHANGES IN STORE TOO. GOVERNMENTS AND PRIVATE UTILITIES ALIKE ARE LOOKING AT INVESTING IN THE INFRASTRUCTURE THAT SUPPORTS OUR ENTIRE ELECTRICAL SYSTEM. BECAUSE ALL THE SUPPLY IN THE WORLD DOESN T DO MUCH GOOD IF IT CAN T GET TO THE USERS. ("The transmission grid was not built to serve a region. It grew like topsy over the past and we really need to take a regional approach to upgrading and expanding that system so that we can deliver power reliably at all times.")</p> <p>(kevin: "The utility structure across the country is state-of-the-art 1970, and a lot has changed in 30 years. And now is the time to start reinvesting some significant money into the infrastructure and that is generation plants and transmission lines.")</p> <p>(Brent: "We need the investment in basic infrastructure, electricity, and communications being the center of it, to allow our economy to grow.")</p> |
|  | <p>CHANGING THE MIX OF RESOURCES WE USE TO GENERATE ELECTRICITY, AND</p>  |

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|  | <p>SHORING UP THE SYSTEM USED TO TRANSMIT IT AND DISTRIBUTE IT, ARE IMPORTANT AND <i>EXPENSIVE</i> STEPS TOWARD ENSURING OUR ENERGY FUTURE. ANOTHER IMPORTANT STEP THAT'S ABSOLUTELY FREE IS CONSERVATION. ACROSS THE BOARD, WHEN IT COMES TO THE FUTURE OF ENERGY, THERE'S AN AGREEMENT THAT CONSERVATION IS AN ESSENTIAL CONCEPT. (Kevin: "Conservation is critical. I guess we would urge customers to really look at their lifestyle and determine do I need this many electronic gadgets around. I'm not saying throw them away or don't use them but certainly understand that to keep pace with the demand it takes a lot of investment and that means there's potential there for the cost of electricity to rise. And so understand simply that there are tradeoffs. That as demand increases, the price of the product increases too.")</p> <p>( Frank: "We're used to consuming huge amounts of power, far more than we need to consume. It requires a little more thinking about what you do, but we could probably reduce our energy consumption by a factor of two quite easily without any significant reduction in our standard of living.")</p> |
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|  | <p>(Harkin: "The single quickest fastest way for us to get the electric energy we need: it s called conservation. That is the fastest and it doesn t mean we all have to put on heavy sweaters in the wintertime and turn our thermostats down. It means doing things better and smarter." )</p>   |
|  | <p>WHO WILL COME UP WITH THESE BETTER AND SMARTER WAYS TO GENERATE, TRANSMIT, DISTRIBUTE, AND CONSERVE THE ELECTRICITY WE RELY ON? YOU. YOU VE GOT THE POWER TO CHANGE THE FUTURE OF ENERGY. SO THE NEXT TIME YOU FLIP A SWITCH, THINK ABOUT EVERYTHING THAT HAD TO HAPPEN TO GET YOU THE POWER YOU RE USING. THEN, THINK ABOUT ALL THE WAYS YOU CAN HELP TO KEEP THAT POWER FLOWING, TO MAKE THE FUTURE OF ENERGY A BRIGHT ONE. (KIDCAM STUFF SQUEEZED TO THE SIDE, WITH CREDITS ROLLING ALONGSIDE)</p> |