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Traffic sunlights

Houston takes hard look at solar-powered devices

In an effort to reduce dependence on fossil fuels, societies across the globe are slowly but steadily implementing the use of alternative sources of energy.

One of these alternatives, solar energy, has become an increasingly popular option as communities have begun evaluating and implementing it in municipal infrastructure applications.

In August 2012, the Texas Southern University Center for Transportation Training and Research performed a pilot study, Feasibility of Solar Powered Traffic Signs in Houston—A Step toward Sustainable Control Devices, funded by Southwest University Transportation Center, that evaluated the installation and maintenance costs of solar panels and LED (light-emitting diodes) retrofits versus the same costs for traditional incandescent light bulbs in traffic-control devices. This article is a synopsis of the results of that study.

Houston, the solar city

A study sponsored by the Arkansas Department of Economic Development found a 90% energy savings in LED signal lights compared with their traditional incandescent counterparts, with averages of 111 kWh versus 1,203 kWh. As a result, the city of Little Rock decided to retrofit all 263 signalized intersections in the city. A reduction in energy cost resulted in savings of $111,000 annually.

In Texas, the city of Houston has been designated as a solar city and has begun the conversion of 300 traffic lights to LED, finding that 85% less energy is being used. The city plans to continue to expand the retrofitting to all other signals in the city and requires all future signal installations to be LED.

The *Journal of Chemical Education* in 2001 published an article detailing the benefits of LEDs compared with the pitfalls of traditional signal lights and their utilization in the transportation industry. The article mentioned the significant differences in typical wattages, 150

watts for incandescent and 20 watts for LEDs, which produce the most energy and cost savings. The article does not neglect to mention that LEDs have a brighter illumination, creating safer road conditions.

Competing lights

On average, the materials' costs of LEDs are 29 times more expensive than that of traditional incandescent bulbs. The labor costs are the same for retrofitting and replacing either type of bulb. However, incandescent bulbs have a much lower life span of 6,000-10,000 hours and may require replacements every year, while the LEDs may last up to 100,000 hours with a life span of up to 11 years.

The typical incandescent bulb uses upwards of 150 watts of power, while LEDs use from 5 to 25 watts of power. Moreover, 90% of the energy given off by incandescent bulbs is through heat energy rather than visible light; LEDs do not have this problem. The LEDs reduce the power consumption tremendously, while the inclusion of solar panels allows for the goal of having zero energy consumption.

It has been tested and proven that running the traditional incandescent light with solar energy is impractical and incredibly expensive, making the LED option more feasible. Retrofitting and installing solar panels and LEDs cost a small fortune, but there are significant savings in the long run. In addition to the LED costs, the total cost estimates will be dependent on the type of installation chosen, such as whether or not the city wants to connect a battery backup, if an existing pole will be retrofitted or a new pole be installed. Labor charges will depend on the options the city decides to put in place. These

The intersections selected for this study were chosen because they are located in major industry areas and support heavy traffic flows on a daily basis. By implementing the LEDs, the energy costs will be five times less than the traditional incandescent route.

installation option scenarios are based on the installation of a two-light system at a four-way intersection, totaling eight traffic-signal lights.

Installation Scenario No. 1: Using existing pole without battery backup

Many cities are able to save money by utilizing existing poles. Upfront, this option saves pole and concrete costs of approximately $3,500. For each set of two traffic-signal lights, one solar module will be installed. At $400 each, four solar modules cost $1,600. The energy generated by the solar panels must provide power to traffic lights daily without fail regardless of weather conditions.

The next decision will be whether or not a battery backup system will be put in place. If a battery backup system is not installed, a grid-tie inverter will be installed to buy and sell energy from a local power provider. For each solar panel, one grid-tie inverter will be installed. At $200 each, the cost for four grid-tie inverters will be $800. The labor charge for the installation of the solar modules, mounting hardware, grid-tie inverters, hardware and wiring will range from $2,000 to $4,800.

Installation Scenario No. 2: Using existing pole with battery backup

This scenario details the costs to be expected for the use of existing poles with the installation of a battery backup system. Six batteries would be required as well as the battery box, solar charge converter and an inverter to power totaling $6,850. A general labor range for the installation of the intersection will run from around $2,000 to $4,800. The total cost per intersection could be around $11,250 to $14,050. The solar modules and mounting hardware would be the same as Scenario 1.

Installation Scenario No. 3: Installing new pole without battery backup

If installers cannot use the current pole to mount the hardware, a new pole will have to be installed. In addition to the materials installed in scenarios 1 and 2, it would require an additional charge for the pole and concrete for $3,500, making the material cost a total of $5,900. General labor costs for the installation at the intersection will range from approximately $2,000 to $4,800. The total cost per intersection could cost around $9,200 to $12,000.

Installation Scenario No. 4: Installing new pole with battery backup

Similar to Scenario 3, if a new pole needs to be installed, it will create an additional charge. Thus adding a battery backup system will make this the most expensive option. The materials needed to install the solar module and hardware are the same as in Scenario 3 at $5,900. The materials needed for battery backup are the same as in Scenario 2, totaling $6,850. The general labor range for the installation of the intersection is the same as the other options at about $2,000 to $4,800. The total cost per intersection could be around $14,750 to $17,550.

At these locations

Galleria (Westheimer at Post Oak)

Westheimer at Post Oak, in the heart of Houston's Galleria area, serves as Houston's premier fashion center and shopping district. This intersection has 12 signal heads housing a total of 40 bulbs. If the intersection's traffic lights are illuminated by 100-watt incandescent bulbs, which equates to 4,000 watts, they will consume 4 kW. By comparison, if the intersection's traffic lights are illuminated by 20-watt LEDs, they will consume 800 watts, or 0.8 kW of power. Since signal lights operate 24/7 this intersection will consume 96 kWh per day on the incandescent bulbs versus 19.2 kWh on the LEDs. If the energy company charges $0.12 per kWh, then the cost of energy per day would be $11.52 on incandescent lighting and $2.30 running on LEDs. In a year's time, the incandescent intersection would cost the city $4,204.80 compared with $840.96, given there are no power outages causing significant restoration delays. Converting the

intersection to LEDs results in a savings of $3,363.84 per year. Using Scenario 1's $5,700-$8,500 solar-installation cost range per intersection, the total installation cost range for both solar and LEDs would be $8,887 to $11,687. Many of the intersections in Houston are built in this configuration, especially those in the main industry corridors of the city.

Greenway Plaza

Located 5 miles west of downtown Houston, the Greenway Plaza is the city's premier master-planned business development. The main entrance at the intersection of Richmond and Timmons separates this area from the many entertainment spots that surround the area. This intersection is identical to the Galleria site in that it has the same number of traffic signals and individual bulbs. By using the same $3,187 total cost for the LED installation and energy power savings of $3,363.84, but using Scenario 4 with a cost per intersection estimate at $14,750 to $17,550, the total installation cost range for both solar panels and LED would be around $17,937 to $20,737.

Texas Medical Center (Braeswood at Holcombe)

The Texas Medical Center is the largest medical center in the world. Located near the internationally acclaimed M.D. Anderson Cancer Center, the intersection of Braeswood and Holcombe also is controlled by 12 traffic-signal lights. By retrofitting the solar-powered LEDs with a battery backup system, the $3,187 total costs for the LED installation (and energy power savings of $3,363.84) with a cost per intersection range of $11,250 to $14,050 (Scenario 2), the total installation cost will range from $14,437 to $17,237.

Museum District (Main at Binz/Bissonnet)

The Houston Museum District is composed of 19 museums within a 1.5-mile radius of the district's core at the popular Mecom Fountain. The intersection at Main where Binz Street becomes Bissonnet Street is a four-way intersection with heavy traffic flow. It has 10 signal heads. Using 100 watts as an average power consumption unit for incandescent bulbs, this intersection would consume 3,200 watts, or 3.2 kW of power. If the intersection is retrofitted with 20-watt LEDs it would consume only 0.64 kW of power.

Illumination by LEDs would consume only 15.36 kW per day compared with 76.8 kW per day consumed by traditional incandescent bulbs. At $0.12 per kW, the cost of energy per day would be 9.216 kWh with incandescent bulbs and 1.8432 kWh using LEDs. The cost of energy per year is $3,363.84 using incandescent bulbs and $672.76 with LEDs, resulting in a savings of $2,691.07. If the $9,200-$12,000 cost range per intersection from Scenario 3 is used for the installation of solar panels at this intersection, the total installation cost range for both solar and LED would be $11,789 to $14,589.

Heavy light savings

The city of Houston has installed LEDs in 10 traffic-control devices as a pilot project. Results from the City of Houston Signal Light LED Project Annual Consumption Comparison indicates there has been a 48-60% savings in energy consumption based on a $0.12 electric rate per kW (blended rate) of how much the city has saved in 2011. The data also indicates an average cost savings in excess of $700 and an average energy savings of 5,888 kW by using LEDs versus traditional incandescent light bulbs.

Unlike other cities throughout the U.S. where initiatives that promote pedestrian and cycling activities are less challenging to implement, the traffic infrastructure system in Houston promotes heavy dependence on the use of cars and roadways to get around the city. As Houston's population continues to grow, the city has to ensure that it is able to accommodate travelers in a safe and orderly way. Houston's Mayor Annise Parker has stated that Houston strives to be the "alternative energy capital of the world." Incorporating solar energy in traffic-signal systems will allow the city to move one step closer to reaching this goal.

The results of this study showed retrofitting the traditional incandescent bulbs to LED is a viable option that saves money and reduces energy consumption. Although this would be a costly venture, the lasting benefits will be seen in less than five years. Installing solar panels will aid in reducing energy consumption to virtually zero. With the solar panel's 35- to 40-year life span, the long-term benefits outweigh the initial costs.

The intersections selected for this study were chosen because they are located in major industry areas and support heavy traffic flows on a daily basis. By implementing the LEDs, the energy costs will be five times less than the traditional incandescent route. The city has already seen the significant savings in energy costs and consumption demonstrated by the 10-intersection analysis. Because this study has demonstrated the substantial benefits of converting traditional traffic-signal systems to solar-powered LED systems, it would behoove the city to continue this retrofitting to all the intersections in Houston. **R&B**

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