Case Study: Tarrant Regional Water District

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Decision Support System

Water Research Foundation (WaterRF) project, **"Decision Support System for Sustainable Energy Management"** (project #4090), resulted in the development of a decision support system (DSS), Excel-based tool to help water utilities explore the results of implementing various energy management options. The tool helps utilities to define categories within their operation that they want to investigate, such as wells, booster pumps, and treatment facilities, and identify more specific entities within the categories (i.e., well #1, well #2) depending on the granularity of the evaluation desired.

A utility must enter its baseline data, a task that provides valuable information and is admittedly time consuming the first time the tool is used. The user selects a base year for which actual data is input for each utility entity including annual energy use, annual energy cost, annual energy recovery or generation, annual greenhouse gas (GHG) emissions using carbon equivalents, and annual operating cost. (Note: the tool provides links to GHG calculators and other energy estimating assistance such as the World Resources Institute [WRI] GHG protocol to inventory GHG emissions). The user must also calculate or estimate energy base projections for two future years, assuming no new initiatives for energy management are implemented.

The user then sets goals for the two future goal years to reflect annual percentage reduction (or increase) for total energy use, GHG generation, renewable energy use or generation, operating expense for energy, and non-renewable energy use. The utility proceeds to identify various energy management options that they wish to evaluate, including an estimate of each option's impact on goals, user defined triple bottom line goals, and capital cost. The tool provides a convenient way to organize data and to compare outcomes of implementing various options in utility entities against the goals for future years. The tool produces outputs of tables and graphs to allow for a visual comparison of the impacts of a range of options on desired goals for decision makers. The following pilot study, adapted from project #4090, illustrates one utility's use of the tool.

Utility Background

Tarrant Regional Water District (TRWD) is one of the largest raw water transmission agencies in the State of Texas, serving 1.7 million people in 2009 in the Metroplex area of North Texas. TRWD operates four large supply reservoirs and three urban terminal storage reservoirs, with over 170 miles of large-diameter pipe. The service area covers 10 counties, and large booster stations are required to pump the supply from outlying sources. As the population and demand of the district's service area continues to grow, and potential future water sources increase in distance from the service area, energy consumption will continue to grow with time.

Deregulation in Texas caused a major shift in how the district, a large energy consumer, viewed their consumption of energy, in terms of cost and efficiency as well as procurement. The district needed a full understanding of energy demand and supply to help insulate it against volatility in the deregulated marketplace. TRWD was also conscious of staying at the forefront of technological advancements to reduce the impact of the district's carbon footprint, as carbon offset regulation is also imminent. Current state legislation requires annual reporting, with active participation in engineering analysis to ensure that energy consumption is maintained at the highest level of efficiency.

Energy Decision Types and Key Questions

TRWD energy management decisions are influenced by a variety of drivers including:

- Compliance with state requirements for reduction of overall energy consumption within a five-year time period
- Implementation of new techniques and green technologies
- Serving the community's best interest
- Reducing cost and operational variability
- Realizing more potential from the existing system and delay capital improvements

Although TRWD utilizes a variety of tools to support energy optimization decisions, a barrier to achieving energy management goals was the lack of a unified framework for evaluating social and environmental benefits associated with various capital and operational choices. TRWD is a large growing utility whose service area has a rapid growth rate, which suggests they will use substantially more energy in the future. To investigate options to mitigate the rate of increase of energy consumption, they decided to participate in piloting the decision support system tool that was developed for the project.

Using the Tool

The utility summary in Figure 1 shows TRWD's 2010 baseline data and expected projections to future years of 2015 and 2020 if changes are not made to reduce energy use. The baseline data projections to the two future years enable TRWD to visualize their expected energy and emissions increase due to growth and development. The base year of 2010 reflects actual data collected by TRWD. The base years 2015 and 2020 reflect best projections based on expected growth. Figure 1 illustrates that most goal areas expect a fairly steady rate of increase with the exception of Energy Recovery/Generation. The graphs that are generated by the tool make it easier for TRWD to determine what goals may be feasible to reach.

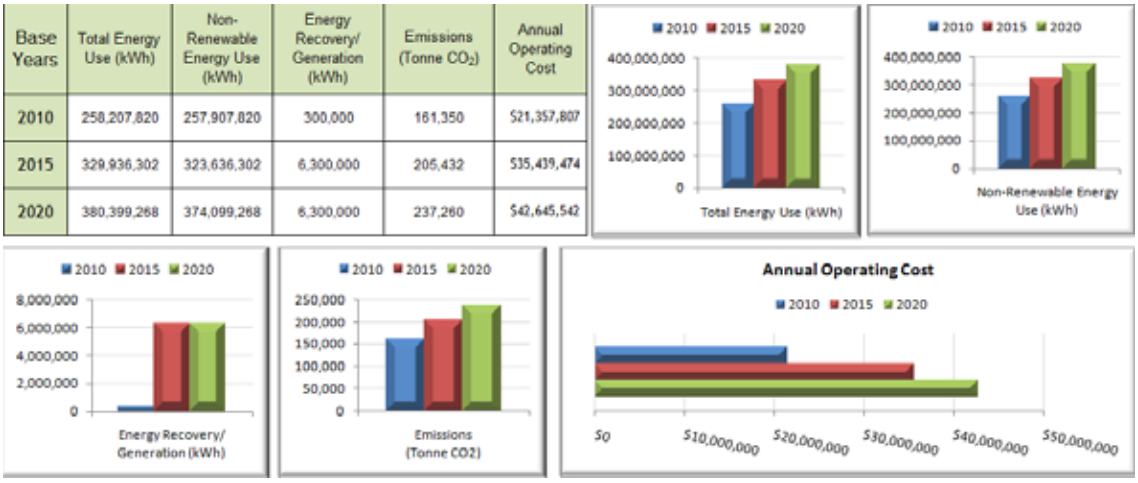


Figure 1. Tool Utility Summary Display of Baseline Data for TRWD

The DSS tool allowed TRWD to set goals for themselves in relation to base year energy use and emissions. Figure 2 is an image of the page of the DSS tool that shows the set of goals. TRWD began with a base year of 2010 and determined five year increments for each of their future goals. They set a goal of 2% for each goal in 2015 and a goal of 5% for each goal in 2020.

TRWD also set triple bottom line goals. These goals are qualitative in nature and as such, the options are either to increase or decrease effects of the goal. They were:

- Increase water conservation participation and realize water savings in the TRWD service area
- Increase demand and energy forecasting efficiency
- Decrease costs and GHG emissions

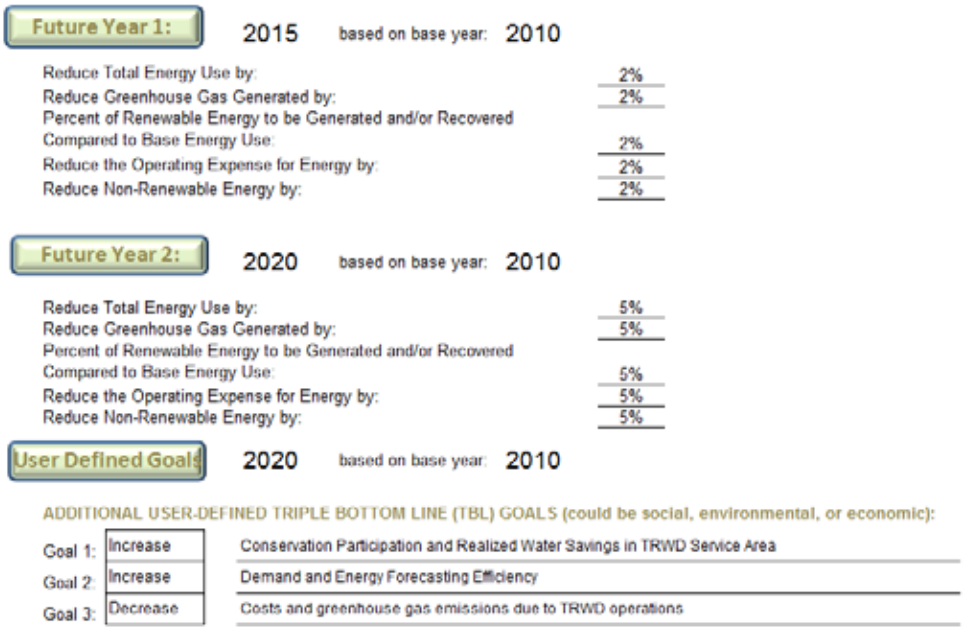


Figure 2. Tool Data Entry Page for TRWD Goals

TRWD brainstormed options to achieve their goals and included options for each of their selected entities (transmission, facilities, fleet). The options that they identified were:

- Utilizing select pump combinations
- Modifying their operating rules based on the long-range weather forecasts
- Obtaining a permit to utilize flood water
- Implementing improved water conservation measures
- Increasing water conservation
- Replacing offices and remodeling an existing warehouse to achieve a Leadership in Energy and Environmental Design (LEED) silver rating
- Conducting energy audits of each office
- Replacing fleet to increase fuel efficiency (2015)
- Replacing fleet to increase fuel efficiency (2020)
- Adding a tier 2 water turbine
- Adding a third transmission line
- Installing solar panels at the pump stations for the third transmission line

Of the above options, numbers 1 through 8, and 10 were selected to be implemented by 2015, while the remaining options (9, 11, and 12) were selected to be implemented by 2020.

Results

Figure 3 illustrates a table generated by the tool showing the base projections for 2015 (assuming no options were implemented), the goals for 2015, and the results of implementing the selected options. It shows that TRWD will be able to achieve all of their goals after implementing the chosen options, with the exception of their Annual Operating Cost for energy.

Future Year 1 Goals

2015	Total Energy Use (kWh)	Non-Renewable Energy Use (kWh)	Energy Recovery/ Generation (kWh)	Emissions (tonne CO_2e)	Annual Operating Cost ($)
Base	329,936,302	323,636,302	6,300,000	205,432	$35,439,474
Goal	253,043,664	252,749,664	5,060,873	158,123	$20,930,651
Results	250,384,979	242,651,979	7,733,000	153,802	$27,120,991

Figure 3. Tool Display of TRWD Goals for Future Year One

The tool generates bar charts to further illustrate this data (Figures 4 through 7). The bar charts help the user visualize that the selected options are sufficient for TRWD to achieve the majority of their goals in 2015. The only goal not achieved is the reduction of annual operating expense.

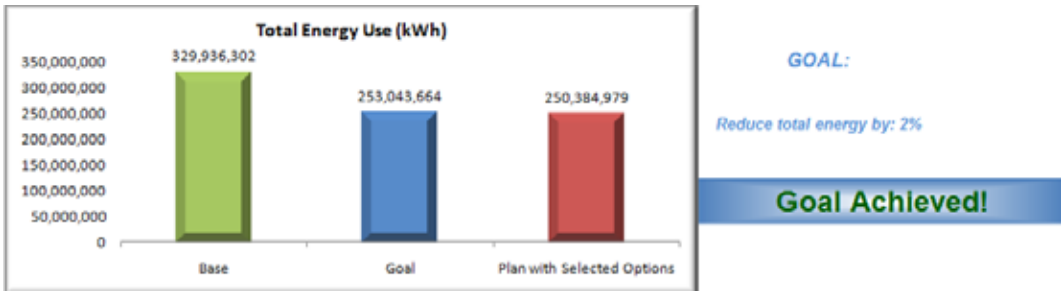


Figure 4. TRWD Results for Reducing Total Energy Use for Future Year One

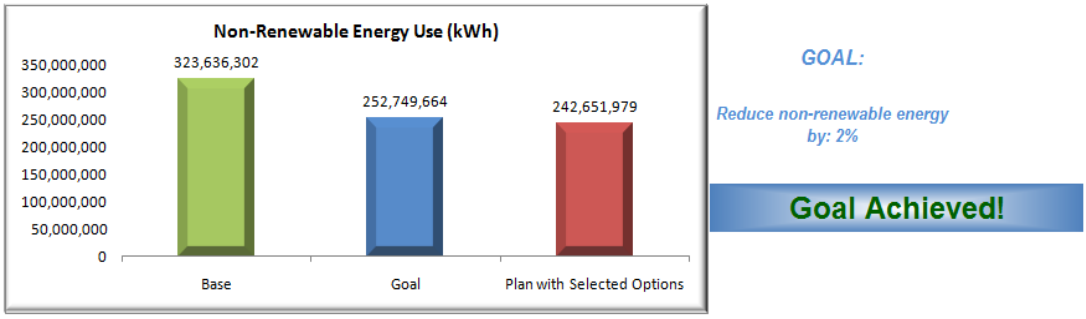


Figure 5. TRWD Results for Reducing Non-Renewable Energy Use for Future Year One

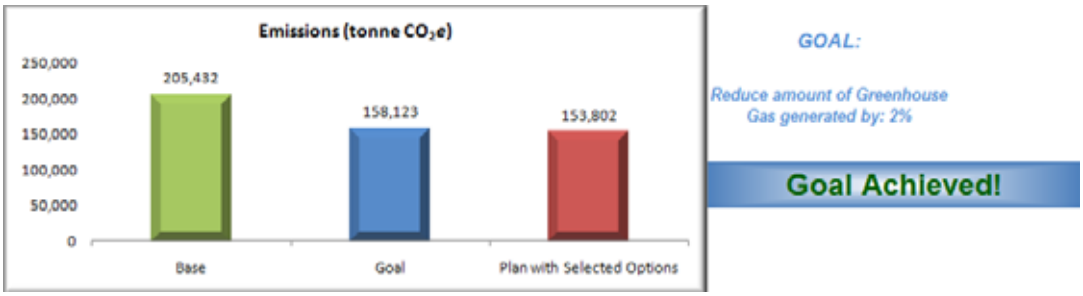


Figure 6. TRWD Results for Reducing Emissions for Future Year One

Figure 7. TRWD Results for Reducing Annual Operating Expense for Future Year One

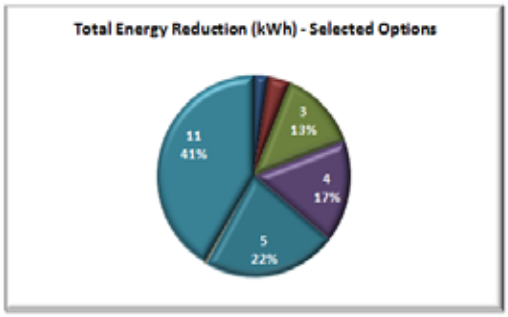
The tool shows that all of their goals would be achieved in the second future year (2020) with the implementation of the additional selected options 9, 11, and 12, as shown in data table in Figure 8.

Future Year 2 Goals

2020	Total Energy Use (kWh)	Non-Renewable Energy Use (kWh)	Energy Recovery/ Generation (kWh)	Emissions tonne CO_2e	Annual Operating Cost ($)
Base	380,399,268	374,099,268	6,300,000	237,260	42,645,542
Goal	245,297,429	245,012,429	12,264,871	153,282	20,289,917
Results	159,945,675	150,712,675	9,233,000	94,835	19,018,341

Figure 8. Tool Display of TRWD Goals for Future Year Two

In addition to illustrating the collective result of selecting all options in a future year, the DSS Tool also generates pie charts and tables that compare the contribution of each of the options to achieving each of the goal areas. The chart and table in Figure 9 illustrates that option 11 (the third transmission line) contributes the most to the total energy reduction goal. Similar pie charts and tables are generated for each goal area (not shown here.)



Option #	Top Options **Total Energy Reduction** - Selected Options (All Years)	kWh	
11	Third Transmission Line	91,270,326	
5	Increased Conservation	49,199,101	
4	Improved Water Conservation Measures	36,379,617	
3	Permit Flood Water	29,217,112	
2	Modify Operating Rules Based on Long Range Weather Forecasts	8,225,000	
1	Select Pump Combination	5,275,544	
9	Fleet Replacement	432,843	
8	Fleet Replacement	262,682	
6	Office Replacement	125,973	
7	Energy Audits of Each Office	65,395	% Decrease
Total of all options for **Total Energy Reduction** - Selected Options (All Years)		220,453,593	38.1%

Figure 9. Tool Display of TRWD Total Energy Reduction Showing Selected Options

Overall, TRWD was able to use the DSS tool to see that significant goal achievement could be made to their operations with various option implementation scenarios. The tool proved useful in organizing data and identifying entities and options to focus their energy management efforts.