8 Potential Resources

GENERAL DISCUSSION

This section provides a description of the resources that were evaluated in the development of this resource plan. Because of its relatively small size, not all resources are true options for the Company. Otter Tail is not sufficiently large enough to construct a large generating facility on its own. This will effectively eliminate some large resource options from consideration.

The development of the resource plan focused on the evaluation of resources that are available to the Company, taking into account a number of factors. These factors include available size increments of the technology, the maturity and commercial availability of the technology, the availability of interested co-owners of large facilities, operational parameters, and available data. One of the significant factors was location of the potential facilities. Otter Tail has experienced some difficulty with transmission availability for purchases of capacity and energy in recent years, similar to the experiences of other area utilities. For that reason, emphasis has been placed on obtaining resources near or within the Company's service territory.

The IRP-Manager model has limits on the number of available resources that can be modeled. A number of resource options were eliminated prior to the IRP-Manager optimization runs. The reasons for eliminating some options are explained later in this section in the discussion of those options. In almost every case there were reasons other than model limitations to eliminate an option. The optimization runs did include the maximum number of generation supply-side options that the model could manage.

Specific cost and performance data used for the computer modeling came from a variety of sources. Much of the specific generator performance came from a Black & Veatch study commissioned by Otter Tail in 2002. Some of the data was provided by the consultant working with the team studying the feasibility of additional generation at the Big Stone Plant site. Much of this data is proprietary in nature. DSM data was provided by the two DSM potential studies completed by consultants hired by Otter Tail, and actual results obtained from the Company's CIP programs in recent years. Additional data on emerging technologies or less traditional technologies was obtained from a variety of sources, including papers, articles, presentations, and studies completed by others.

8-2 Potential Resources

Otter Tail considers much of the specific cost and performance data of the potential resources to be proprietary in nature. Responses to the RFP are covered by a confidentiality agreement prohibiting disclosure. For those reasons, Otter Tail has intentionally omitted such data from the filing. It is the Company's intent to provide it to the Department of Commerce, and therefore the Commission, through a data request if such a data request is received.

CAPACITY PURCHASES

Otter Tail contacted area utilities and other known entities within the region close to the Company's service territory to explore the potential to purchase long-term capacity and energy. To those entities that indicated having available resources or the expectation of available resources, a written Request-For-Proposal (RFP) was issued. The only proposals received were from MHEB.

Excelsior Energy

Excelsior Energy was contacted in late 2003 to seeks proposals from the planned coal gasification project in northern Minnesota, both by telephone and via the issuance of an RFP. They declined to make a proposal.

Manitoba Hydro Electric Board

Otter Tail received three proposals from MHEB in response to an RFP issued to them for baseload and peaking capacity proposals. The proposals included a variety of megawatts of capacity, energy availability, and options for load following service. The baseload proposals were requested to be similar in scheduling and operation to a baseload generating unit for comparison against other baseload options. Otter Tail included the proposals in the IRP analysis. The specific proposals are covered by a confidentiality agreement, so details cannot be provided in this section of the document.

SUPPLY-SIDE GENERATION

The Big Stone Plant II (BSPII) consortium investigated a number of baseload generation technologies including sub-critical pulverized coal, super-critical pulverized coal, atmospheric circulating fluidized bed combustion coal (ACFB), integrated gasification combined cycle (IGCC), and large natural gas-fired combined cycle (CCGT). A discussion of each of the coal-fired technologies and other supply-side technologies is included in the following pages.

Pulverized Coal - Subcritical

Pulverized coal boiler technology is a mature and reliable energy producing technology around the world. The operating pressure of conventional coal-fired power plants can be classified as sub-critical and super-critical. Sub-critical and super-critical technologies refer to the state of the water that is used in the steam generation process. The critical point of water is 3208.2 psia and 705.47° F. At this critical point, there is no difference in the density of water and steam. At pressures of about 3208.2 psia, heat addition no longer results in the typical boiling process in which there is an exact division between steam and water. The fluid becomes a composite mixture throughout the heating process. A sub-critical pulverized coal unit was eliminated from consideration as a BSPII option because of the many inherent benefits of a super-critical pulverized coal unit including higher efficiency at full load, higher efficiency at partial loads, and reduced emissions.

Atmospheric Circulating Fluidized Bed Coal (ACFB)

The consideration of a baseload coal-fired unit at the Big Stone Plant site included evaluation of a large ACFB facility. The combustion within a fluidized bed boiler occurs in a suspended bed of solid particles in the lower section of the boiler. Combustion within the bed occurs at a slower rate and lower temperature than a conventional pulverized coal boiler. Deviations in fuel type, size, or Btu content have minimal effect on the furnace performance characteristics. The bed allows for re-injection of a sorbent, such as fly ash or limestone, to reduce SO_2 emissions. This type of operation requires approximately 1.5 times the quantity of limestone to achieve a reduction in SO_2 similar to that of a wet limestone scrubber. All ACFB boilers built to date have been sub-critical designs.

One of the benefits of an ACFB facility would have been an increased ability to use biomass fuels. The BSPI unit already has an alternative fuels handling facility and the capability to burn alternate fuels. There has been difficulty in expanding the use of biomass fuels at BSPI due to cost and availability. The benefit of being able to use biomass fuels was outweighed by a number of other factors, and a large fluidized bed unit was eliminated from consideration as a BSPII project. Otter Tail does not have a fluidized bed coal-fired alternative available in an economic size, and therefore was not included in the IRP analysis.

8-4 Potential Resources

Pulverized Coal – Supercritical

Super-critical pulverized coal units have been part of the U.S. power generation mix since the mid-1950's. Since the 1980's, the development of high strength materials and Distributed Control Systems (DCS) have helped to make supercritical units easier to control and operate. Super-critical units typically operate at 3500 psig and at 1000° F. or 1050° F. at the steam turbine inlet. Conventional super-critical units can be expected to provide an increased efficiency of 3-4 percent over sub-critical units at a temperature of 1050° F. Supercritical units are also more efficient at partial loads.

The BSPII group has selected a 600 MW super-critical pulverized coal-fired facility for further design analysis and evaluation as a potential project. The facility would include low NO_x burners and Selective Catalytic Reduction (SCR) for NO_x control. A baghouse would be included to remove particulate from the flue gas. The flue gas desulfurization (FGD) system chosen is a wet limestone, forced oxidized (WLFO) scrubber, capable of 95% or higher SO_2 removal.

The by-products of the unit, assuming a WLFO scrubber, are bottom ash, fly ash, and gypsum. Bottom ash can potentially be used for road base and other commercial purposes. Fly ash could potentially be utilized as structural fill for developing new roads and for mixing with concrete. Additionally, the gypsum produced by a wet FGD system potentially could be used for making wall board or supplementing cement.

As of the filing date of this resource plan, Otter Tail has rights to 116 MW of the potential BSPII project. The IRP base case analysis included potential 50, 25, 20, 10, 10, and 5 MW blocks to allow the model to pick various combinations of MW levels up to 120 MW of a BSPII unit. A further sensitivity analysis was conducted to determine if more than 120 MW of BSPII would be economic if additional capacity became available.

Integrated Gasification Combined Cycle (IGCC)

The BSPII group considered a 550 MW (net) electric generating station comprised of two coal gasifiers, two "F" class gas turbines each coupled to a heat recovery steam generator (HRSG), and a single, reheat steam turbine. IGCC technology produces a low energy value syngas from coal or solid waste, for firing in a conventional combined cycle plant. The gasification process in itself is a proven technology having been previously utilitized extensively for production of chemical products such as ammonia for use in fertilizer.

However, utilizing coal as a solid feedstock in a gasifier for power generation is currently under development. The U.S. Department of Energy (DOE) has jointly funded several power plant facilities through the U.S.

The majority of the DOE test facilities utilize entrained flow gasification design with coal as feedstock. In that process, coal is fed in conjunction with water and oxygen from an air separation unit, into the gasifier at around 450 psig where the partial oxidation of the coal occurs. The raw syngas produced by the reaction in the gasifier exists at around 2400° F. and is cooled to less than 400° F. in a gas cooler, which produces additional steam for both the steam turbine and gasification process. Particulate, ammonia (NH_3), hydrogen chloride, and sulfur are then removed from the raw syngas stream. The cooled and treated syngas then feeds into a modified combustion chamber of a gas turbine specifically designed to accept the low calorific value syngas. Exhaust heat from the gas turbine then generates steam in a HRSG which in turn powers a steam turbine.

Three gasifier manufacturers have IGCC experience with various U.S. coals. Each of the manufacturers has a slightly different technology that has proven to work differently on different fuels. Of the currently operating U.S. IGCC units, none are operating on low sulfur sub-bituminous Powder River Basin (PRB) coal. Testing of various coals on the different gasifiers is continuing, however, at the present time there is no long-term commercial operating IGCC experience with PRB coal.

Unit availability at the DOE jointly funded units has been improving, but these units have experienced downtime for design modifications and replacement of equipment. Only two units, Polk County and Wabash River, have achieved extended periods of commercial operation. These two units achieved an approximate 83% availability in 2003, but the other units and earlier operating years for these two units have been well below that level. Capital costs are still at least 20% higher than the cost of pulverized coal facilities, with typical availabilities 10-15% below that of pulverized coal units.

Therefore, the BSPII evaluation concluded that IGCC is not commercially feasible for the potential project at this time. It is recognized that IGCC shows potential to become a reliable, low emission source of electrical energy in the future. Otter Tail did include IGCC as an option for the planning model beginning in 2015 based on the premise that further testing and development could bring IGCC utilizing PRB coal to commercially viable status by that time period. Since Otter Tail does not have potential co-owners in a large IGCC facility, the model was allowed to evaluate an IGCC unit based on a Hitachi 2025 combined cycle facility rated at about 81 MW at ISO conditions.

Combined Cycle Gas Turbine (CCGT)

The basic principle of the Combined Cycle Gas Turbine is to use a gaseous fuel such as natural gas, or a liquid fuel such as no.2 fuel oil, to produce power in a gas turbine and to use the hot exhaust gases from the gas turbine to produce steam in a HRSG. The steam would be used to generate electric power with a steam turbine generator. Typical CCGT units operate with natural gas as the operating fuel, but often dual-fuel capability with oil is used to increase the availability of the generation when natural gas supplies are curtailed.

The BSPII evaluation included consideration of a 500 MW CCGT unit comprised of two "F" class gas turbines, two HRSG units, and a single reheat steam turbine. The BSPII project evaluation eliminated this alternative for consideration as a BSPII project.

Otter Tail did not model a portion of a large CCGT, but did allow the model the opportunity to evaluate several smaller CCGT units. The specific combined cycle units that were included in the model were:

- 1 x 1 CCGT utilizing a GE Frame 7EA combustion turbine and a HRSG to provide a unit with an ISO rating of about 128.2 MW. About 83.9 MW would come from the combustion turbine and 43.2 MW from a steam turbine tied to the HRSG.
- 2 x 1 CCGT utilizing two GE LM6000PC aeroderivative combustion turbines and a single HRSG to provide a unit with an ISO rating of about 107.45 MW. About 84.25 MW would come from the combustion turbines and 23.2 MW from a steam turbine tied to a single HRSG.
- 2x1 Hitachi 2025 CCGT utilizing two Hitachi H-25 combustion turbines and a single HRSG to provide a unit with an ISO rating of about 81.36 MW. About 53.86 MW would come from the combustion turbines and 27.5 MW from the single HRSG.
- 1 x 1 CCGT utilizing a GE LM6000PC and a HRSG to provide a unit with an ISO rating of about 53.52 MW. About 42.12 MW would come from the combustion turbine and 11.4 MW from the HRSG.

Simple Cycle Combustion Turbine

The model was given multiple units of two simple cycle combustion turbines to evaluate for installation. The first is a GE Frame 7EA heavy-duty unit with an ISO rating of about 83.9 MW. The heavy-duty frame units are characterized by a lower capital cost per kW and lower maintenance cost, but a higher heat rate than an aeroderivative machine. The second simple cycle combustion turbine option within the model was based on a GE LM6000 PC with an ISO rating of about 42.12 MW. The combustion turbines were based on operation on interruptible natural gas with dual-fuel capability based on fuel oil.

Phosphoric Acid Fuel Cell (PAFC)

The model evaluation included the option to select up to two 20 MW blocks of fuel cells. The fuel cell blocks were based on the ONSI PC25 phosphoric acid fuel cell, fueled with natural gas. Fuel cells function by converting hydrogen-rich fuel sources directly to electricity through an electrochemical reaction. Fuel cells can sustain high efficiency operation even under partial load conditions and they have a rapid response to load changes. The construction of fuel cells is inherently modular, making it easy to size facilities according to power requirements.

One of the most significant benefits to fuel cells is the lack of emissions. The only significant emissions are water and carbon dioxide.

There are other fuel cell technologies under development and undergoing demonstration, but none of those is sufficiently developed at this time to be included in the analysis.

Wind

The base model included the existing wind generation on the Otter Tail system, plus the proposed 70.5 MW Enbridge wind farm. The Enbridge Wind Farm proposal has been submitted to the regulatory commissions in all three states for approval. An additional 20 MW of wind was manually forced into the model in 2014 to ensure compliance with the Renewable Energy Objective (REO) contained in MN Stat. §216B.1691.

Additional 20 MW blocks of wind were included in the analysis as alternatives for the model. The financial costs of modeling wind are a great uncertainty at this point in time due to the status of the federal Production Tax Credit (PTC). The PTC is currently set to expire at the end of 2005. The future of the

PTC is uncertain, especially in the later years of the planning period. The cost of adding wind generation can vary by 60% or more depending upon the status of the PTC. To overcome this degree of uncertainty, the modeling also included a sensitivity analysis of wind costs at various levels and determining when the model would pick additional wind under each price scenario.

Hydro

For past resource plan filings Otter Tail has reviewed the potential for cost-effective small hydro development within its service territory. A MN Department of Natural Resources survey of potential sites within the state served as a basis for that review. The DNR conclusion was that the existing economic sites had already been developed. For that reason, Otter Tail did not include any potential development of small hydro within the model.

Even if potential sites existed within the Company's service territory, it is unlikely that they would be economic for development if the sites were under FERC jurisdiction. If a waterway has a designation as a navigable stream, then it falls under FERC jurisdiction. Otter Tail's small hydros on the Otter Tail River near Fergus Falls were all built prior to FERC licensing requirements. The Otter Tail River was designated as a navigable stream because in the 1800's it was used for transportation and to float logs to the sawmill. In the late 1980's and early 1990's, Otter Tail was ordered to obtain FERC licensing on these units. The licensing process took several years and cost about $400/kW, for existing units. The licensing cost for developing a new site is likely to be so high as to make the process uneconomic.

Otter Tail does have a customer that is considering repowering an old site upon which the Company previously had operated a small two-unit hydro. Both of those units were retired in 1952. The total site rating at that time was 176 kW, which is too small to impact the results of the analysis.

Pumped Storage Hydro

The State of Minnesota has a site that it has promoted for development as a pumped storage hydro facility. In October 1995 the DNR issued a Request for Development Interest regarding a potential pumped storage hydro facility at Hill-Annex State Park. The site is a potential 75 MW closed storage system using the old Majorca mine pit. An engineering study performed in 1993 by Barr Engineering reviewed a number of sites in the area and identified potential capital costs of $867/kW - $1,235/kW at that time.

This alternative was not included in the model. Otter Tail has extensive load management capability over the winter peak, which is the Company's annual peak. The load shape is relatively flat on peak and near-peak days from early in the morning until almost midnight. The Company already has difficulty at those times finding opportunities to restore customer load that has been shed. The Company does not have an off-peak reduced load period that could be used to recharge a pumped storage hydro facility for use during the day.

Solar Photovoltaic

Solar photovoltaic technology was not included in the model as a generating option, due to continuing high costs. Cost estimates for solar photovoltaic capacity installed in 2004 in the U.S. ranged from $6,500/kW to $9,000/kW.[1] That cost is substantially above the cost of other non-fuel technologies and would not be selected by the model as part of the resource plan.

Otter Tail was working with a customer in 2004 on the potential installation of a system, but the customer moved from the area and the project was dropped. The Company currently has another customer that is considering the installation of a system. Any initial installation of a solar photovoltaic system by the Company is likely to be part of a CIP project under the renewable energy provision contained within the CIP statute.

Anaerobic Digestion

Otter Tail has completed a preliminary assessment of anaerobic digester potential in its service territory. Anaerobic digestion of manure can be used to produce biogas, containing anywhere from 55 – 80% methane. The biogas, with proper handling, can be burned directly in an internal combustion engine to generate electricity. The amount of biogas available from manure varies by type of livestock, and can also vary significantly within the same type of livestock based on feed, manure collection and treatment, etc. Anaerobic digestion requires a facility where manure is collected daily, and where a digester can be properly fed and maintained at optimum conditions.

The AgSTAR program is a voluntary program designed to encourage the widespread use of livestock manure as an energy resource. The U.S. Environmental Protection Agency website contains information

[1] reFOCUS Magazine, May/June 2005, pg.3.

on anaerobic digestion, and a handbook is available for download at www.epa.gov/agstar/library to guide the user through an assessment. The guide recommends a minimum of 300 head of dairy cattle and 2,000 swine when considering anaerobic digestion. A preliminary survey of potential anaerobic digestion locations on the Otter Tail system has identified limited resource availability. Dairy herd potential indicates possible capacity of 390 – 720 kW with annual energy production of 3,075,000 – 5,676,000 kWh. Swine herd production indicates a possible potential of 333 – 501 kW with an annual energy production of 2,634,000 – 3,951,000 kWh. Otter Tail included swine herds as small as 1,000 head in conducting the survey.

Turkey farms are also present on the Company system, although many have already committed their manure and waste bedding to the turkey manure fired facility under construction in western Minnesota.

The economic development potential of anaerobic digestion for generation is very site specific. The economics would be better if anaerobic digestion was already required for odor control, but none of the three states in which Otter Tail serves customers has such a requirement. Anaerobic digestion when used on the farm is a multi-faceted approach to resource management. Any evaluation needs to take into account electricity costs, fertilizer costs, waste handling costs, and any avoided heating costs associated with waste heat collection. The amount of potential generation that may result on the system is at the most 1.2 MW, too small to be of consequence to this resource plan filing. Anaerobic digestion was not included as a generation option within the model.

Landfill Gas

According to an EPRI report completed in the late 1990's, the Otter Tail Service territory does not include any landfills of sufficient size to support a landfill gas generating facility. The only two landfills in the area that were identified were at Fargo and Grand Forks, both served by another utility. Each of those landfills was identified as having the potential to support two 2 MW generators. Landfill gas was not included as an option within the model.

Microturbines

Microturbines are miniature combustion turbines, similar in concept to the large combustion turbines used in conventional utility power plants. Whereas large combustion turbines range from 20,000 to over 200,000 kW, microturbines fit into the 25 to 400 kW range. Microturbine efficiencies have not met early manufacturer projections of mid-30 percent and higher. Most available units are in the mid-20's for efficiency in a standalone configuration. The waste heat from the turbine exhaust can be collected to supply a useful thermal load, which improves the overall cycle efficiency and the economics. However, the capital costs are still higher than the cost of a standard utility size combustion turbine and the efficiencies are much worse. At this point in time, potential economic applications are somewhat limited.

Otter Tail, in its last CIP filing, had proposed a natural gas-fired cogeneration facility based on a microturbine that would be tied to a community center in the service territory. Waste heat from the exhaust would be used to help heat the water for the swimming pool. The purpose was to evaluate a microturbine in a setting that was well suited for the technology. As development work on the proposal continued, it became quite evident that even under the most optimistic of circumstances, the economics were still very poor. The Company chose to discontinue the proposal.

The model did not include consideration of microturbines due to their small size, limited application at this time, and high cost.

Biomass

Otter Tail has been purchasing 50% of the capacity and energy from an 11.5 MW wood waste fired biomass facility since 1992. This cogeneration unit is associated with a wood products plant owned by a customer. During 2004, the wood products plant and the cogeneration plant were sold to another company. The PPA for the capacity and energy expired on December 31, 2004. The new owners were willing to sign a PPA for the calendar year of 2005 only. During 2005 the company plans to evaluate their energy balance in their wood products production facility to determine if the steam heat created by the cogeneration plant can be used to offset natural gas usage. If their analysis shows that the cogeneration plant steam can be used in place of natural gas usage, electricity generation at the site is likely to cease.

It is Otter Tail's intent to continue to purchase this biomass energy for as long as it is available at a justifiable price.

Since the early 1990's Otter Tail has made an effort to use renewable fuels in its existing coal-fired plants. The Big Stone Plant has successfully burned a number of renewable and alternate fuels over the years and has an alternative fuels handling facility to aid in blending such fuels in with coal. Some of the renewable fuels that have been tried or researched over the years include spoiled or research corn seed, wood waste in various types, soybeans, beet pulp, sunflower hulls, and similar agricultural wastes. Some of these materials caused significant problems in test burns by either plugging fuel handling systems (bark wood waste) or plugging boilers (soybeans). Sunflower hulls and soybeans have proven to be problematic due to their high content of potassium.

Otter Tail did not include any other additional biomass alternatives in the model. As the cost of fossil fuels increases, other markets develop for biomass fuels such as wood waste. In many cases, the wood products companies that create the waste use it as fuel in their own process. Otter Tail has experience with the customer owned 11.5 MW wood waste fired facility and has worked with other customers on potential wood waste fired biomass facility investigations. The fuel supply is limited and the costs of such facilities are high. The development potential of these facilities is limited and very site specific. To date, Otter Tail has not found other opportunities for development of such facilities with costs being close to economic.

Geothermal

Otter Tail has worked with the Geology Dept. at the University of North Dakota on investigating the potential for geothermal energy. Western North Dakota has geothermal resources in temperature ranges that would be suitable for binary cycle geothermal technologies. A binary cycle facility typically pumps natural water or brine from underground that has been heated by the earth to moderate temperature ranges of 200° F. - 500° F. The heat in the fluid is transferred to another working fluid such as iso-pentane which is used in place of water in a normal thermal generation mode. The brine is then reinjected back into the earth. The extraction and reinjection wells are typically from 1,000 – 3,000 feet deep and require significant horsepower to extract the fluid and then reinject it. The resources in western North Dakota are located much too deep to be economic for binary cycle operation, typically in the 10,000 – 12,000 foot range. Otter Tail did not include any geothermal options as potential generating resources in the model.

Otter Tail does have geothermal heat pumps as programs within its CIP process.

The binary cycle technology used for moderate temperature resources would work with any source of waste heat that falls within the moderate temperature range and in sufficient quantity to support a binary cycle unit. Otter Tail has been involved in investigating waste heat generation from combustion turbines used at natural gas compression stations on pipelines. Otter Tail has also searched for other potential waste heat streams that could be used to support a small binary cycle facility. ORMAT is a company that has binary cycle units in the 1.5 – 5 MW range that are designed to be operated remotely. One of the difficulties for developing a small waste heat recovery facility that has been identified is that the State of Minnesota rules require full time staffing of such a facility any time working pressures are in excess of very low pressures. The labor requirements to have staffing 24 hours per day significantly increase the costs and make such facilities uneconomic.

CONSERVATION

Otter Tail included 25 conservation technologies in the modeling database for consideration by IRP-Manager. The conservation data included within the model came from two DSM potential studies that have been conducted on the Otter Tail service territory. The data was screened, both manually and with DSManager software to eliminate DSM technologies that were no longer appropriate or had no chance of being selected.

The conservation data process began with the results from the DSM potential study that was completed in 1993. These results had previously been screened with the DSManager model.[2] DSM technologies that did not have a benefit/cost ratio of at least 0.9 were not considered beyond this point. The remaining technologies were reviewed to ensure that they were still relevant. For example, an insulating technology to install R-19 wall insulation is certainly appropriate in retrofit applications, but not in new construction where building codes already require R-19 insulation. In those instances, the market potential due to new construction was removed from the data.

A second targeted DSM potential study was completed in 2002. For those 2002 technologies that were the same as the earlier study technologies, the 2002 data was used to replace the older data. The 2002 DSM potential study results were not prescreened with DSManager but were modeled in IRP-Manager.

Finally, the results of prior CIP programs as approved by the Commission were reviewed. Any CIP programs that matched the DSM technologies had the results of those technologies removed from the market potential data. The remaining data and technologies were all included within the IRP-Manager database for consideration in the optimization runs. It is worth noting that even though IRP-Manager did not select all of the DSM programs in the database, it did select greater amounts of DSM than in past resource plans.

The current resource plan covers the 2006-2020 planning period. The load forecast results were completed prior to the 2004-2005 CIP programs and the planning period starts after these programs. The 2004-2005 CIP programs were manually selected in the model as being implemented so that the model included the impacts.

The Otter Tail CIP includes programs and/or technologies for which the Company does not have market potential data. Examples of this include the House Therapy program targeting low-income opportunities, and the commercial/industrial grant programs where customers can propose a conservation scenario that fits their needs and specific situation. There are several others as well such as educational programs or training programs that do not have directly identifiable savings. These programs are manually included within the model, and are not alternatives from which the model can select.

The conservation alternatives available to the model covered a variety of end-uses, and some are identified below:

- Building Envelope
    - Residential Insulation (wall and ceiling)
    - Commercial Insulation (wall and ceiling)
    - Industrial Insulation (wall and ceiling)
    - Residential Low E Windows
    - Commercial Low E Windows
    - Residential Storm Windows
    - Residential Window Film
    - Residential Caulking and Weatherstripping
    - Commercial Caulking and Weatherstripping

- Space Conditioning
    - Residential Air to Air Exchanger
    - Commercial Air to Air Exchanger
    - Industrial Solid State Enthalpy

[2] DSManager is a companion software package to the IRP-Manager planning model. The IRP-Manager model is used to develop a chronologic output file with load, system cost, and day-type information that is imported to DSManager. DSManager can then evaluate DSM technologies for cost-effectiveness.

- Lighting
  - Commercial Lighting
  - Industrial Lighting
  - Commercial Outdoor Timeclocks
  - Industrial Occupancy Sensors
  - Optical Reflectors
  - Delamping

- Other
  - Energy Efficient Motors
  - Adjustable Speed Drives
  - Vendmiser
  - Commercial Cooking Measures
  - Residential Water Heater Blankets
  - Commercial Water Heater Blankets
  - Refrigeration Heat Recovery
  - Lower Water Heater Temperature
  - Low Flow Shower Head

Each conservation technology was modeled as a multi-year program, which included the costs of implementation and the value of avoided transmission and distribution investments.