DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Product: Compressed Air Efficiency

Custom and prescriptive rebates will be offered under the compressed air product. Prescriptive rebates are available for Variable Frequency Drive Compressors that are less than 50 hp, and no air loss drain valves. Other measures may receive rebates through the Custom Efficiency product. Each custom efficiency project will be analyzed individually by Xcel Energy. Engineering variables required for the analysis will be obtained from the customer or vendor. Analysis will be based on standard engineering methodologies.

Algorithms:

VFD Comp Electrical Demand Savings (Customer kW)	= HP x Service Factor x 0.746 x (%_Load_b / Motor_Effb - %_Load_h / Motor_Effh)
VFD Comp Electrical Energy Savings (Customer kWh)	= Demand Savings (Customer kW) x VFD_Hours
No Loss Air Drains Electrical Energy Savings (Customer kWh)	= Number_of_Drains x kW_per_Drain x Drain_Hours
No Loss Air Drains Electrical Demand Savings (Customer kW)	= Number_of_Drains x kW_per_Drain

Electrical Energy Savings (Gross Generator kWh)	= Customer kWh / (1-TDLF)
Electrical Demand Savings (Gross Generator kW)	= Customer kW x CF / (1-TDLF)
Electrical Energy Savings (Net Generator kWh)	= Gross Generator kWh x NTG
Electrical Demand Savings (Net Generator kW)	= Gross Generator kW x NTG

Variables:

HP	= HP of new Compressor provided by the customer
Service_Factor	= Service factor of the motor, we will use 1.1 (Reference 1)
0.746	= Standard conversion from HP to kW.
%_Load_b	= Average percent loading for baseline compressor = 0.8952 as calculated on %BHP to %Flow tab
%_Load_h	= Average percent loading for VFD compressor = 0.61 as calculated on %BHP to %Flow tab
Motor_Eff_b	= Efficiency of existing compressor motor as determine in Table 1 using customer provided HP.
Motor_Eff_h	= Efficiency of new compressor motor as determine in Table 1 using customer provided HP.
VFD_Hours	= Operating hours of compressors from Table 1.
Drain_Hours	= Operating hours of compressed air systems. We will use 5823 hours which is an average of completed CO custom compressed air project hours.
Number_of_Drains	= Number of drains replaced will be provided by the customer
kW_per_Drain	= kW savings per drain, we will use 0.53 kW per calculations on Forecast NLAD tab.
TDLF	Transmission-Distribution Loss Factor = 6.5%, the percentage loss of electricity as it flows from the power plant to the customer, calculated using factors from Enhanced DSM Filing SRD-2
CF_VFD	= Coincidence Factor - Probability that the measure peak demand reduction will occur at the same time as the grid peak demand, we will use 88.8% for small VFD compressors based on historic small VFD compressor projects in MN and CO.
CF_NLAD	= Coincidence Factor - Probability that the measure peak demand reduction will occur at the same time as the grid peak demand, we will use 69% for No Loss Air Drains based on historic custom compressed air projects in CO.
NTG	Net-to-gross = We will use 87% for Compressed Air projects (Reference 2)

Incremental operation and maintenance cost	= 0 - conservative approach, taking no credit for improved mean time between failure.
Incremental Cost of Efficient Equipment	= Incremental cost of efficient measures from Table 2. Compared to the do-nothing option.

Provided by Customer:	**Verified during M&V:**
Size of Compressor	Yes
Number of Drains	Yes
Whether compressor is new or a replacement	

Assumptions:

VFD Compressors<50 hp

Compressed air system in which VFD compressor is installed must have a capacity < 50hp.

Existing compressor was a non-reciprocating load/no load type with a minimum of 1 gallon of storage per cfm capacity, or modulation with or without unload.

No Loss Air Drains

Compressor must be one of the following:

Load/no-Load with at least 5 gal/CFM of storage (180 CFM compressor would need to have 5*180=900 gallons of storage or more)

Variable Speed Drive compressor

Variable Displacement/Capacity compressor

Centrifugal compressors in their efficient trim range without any blowoff to atm.

Table 1. Motor Efficiencies from NEMA

Compressor HP	Motor Description	Plan A Baseline Motor Efficiency	Plan B Existing Compressor Motor Efficiency	Plan A and Plan B New Compressor Motor Efficiency	Original Operating Hours	Revised Operating Hours
10	10 HP 1800 RPM ODP	89.5%	86.3%	89.5%	~~3391~~	2131
15	15 HP 1800 RPM ODP	91.0%	87.2%	91.0%	~~3391~~	2131
20	20 HP 1800 RPM ODP	91.0%	88.1%	91.0%	~~3391~~	2131
25	25 HP 1800 RPM ODP	91.7%	88.9%	91.7%	~~4067~~	3528
30	30 HP 1800 RPM ODP	92.4%	89.4%	92.4%	~~4067~~	3528
40	40 HP 1800 RPM ODP	93.0%	89.7%	93.0%	~~4067~~	3528

Existing Compressor Motor Efficiency values are from Pre-EPAC motors

Plan A Existing Compressor Motor Efficiency and New Compressor Motor Efficiency values are from

Operating hours from completed MN and CO custom projects 2007-2008

Compressor hours from United States Industrial Electric Motor Systems Market Opportunities Assessment, EERE, US DOE, Dec 2002 - Source for operating hours for industrial motors and source for load factor (Table 1-18 and 1-19)

Table 2. Incremental Costs for Efficient Measures	Replacment Program (Plan B)	New Program (Plan A)
10 HP VFD Compressor	$10,841	$2,577
15 HP VFD Compressor	$14,018	$2,694
20 HP VFD Compressor	$16,879	$3,609
25 HP VFD Compressor	$19,561	$5,149
30 HP VFD Compressor	$24,357	$7,212
40 HP VFD Compressor	$27,429	$7,468
No Loss Air Drain	$448	

Compressor prices are the average price from three retailers plus $1500 for installation as calculated on VFD info tab
NLAD price is average of nine retailers prices as calculated on Forecast NLAD tab

Changes from 2011
No changes.

References
(1) Service factor (1.1) from Compressed Air & Gas Institute (CAGI) standards comparing Nameplate HP to actual BHP @ 100% Full rated pressure and flow
(2) National Energy Efficiency Best Practices Report (http://www.eebestpractices.com)