### 4.4.19 Demand Controlled Ventilation

**Description**

Demand control ventilation (DCV) adjusts outside ventilation air based on the number of occupants and the ventilation demands that those occupants create. DCV is part of a building's ventilation system control strategy. It may include hardware, software, and controls as an integral part of a building's ventilation design. Active control of the ventilation system provides the opportunity to reduce heating and cooling energy use.

The primary component is a control sensor to communicate either directly with the economizer or with a central computer. The component is most typically a carbon dioxide (CO2) sensor, occupancy sensor, or turnstile counter. This measure is applicable to multiple building types, and savings are classified by the specific building types defined in the Illinois TRM. This measure is modeled to assume night time set backs are in operation and minimum outside air is being used when the building is unoccupied. Systems that have static louvers or that are open at night will likely have greater savings by using the custom program.

This measure was developed to be applicable to the following program types: RF. If applied to other program types, the measure savings should be verified

**Definition of Efficient Equipment**

The efficient equipment condition is defined by new CO2 sensors installed on return air systems where no other sensors were previously installed. For heating savings, this measure does not apply to any system with terminal reheat (constant volume or variable air volume). For terminal reheat system a custom savings calculation should be used.

**Definition of Baseline Equipment**

The base case for this measure is a space with no demand control capability. The current code minimum for outside air (OA) is 17 CFM per occupant (ASHRAE 62.1) which is the value assumed in this measure.

**Deemed Lifetime of Efficient Equipment**

The deemed measure life is 10 years and based on CO2 sensor estimated life. [[1]](#footnote-1)

**Deemed Measure Cost**

The deemed measure cost is assumed to be the full cost of installation of a DCV retrofit including sensor cost ($500) and installation ($1000 labor) for a total of $1500[[2]](#footnote-2).

**Loadshape**

Commercial ventilation C23

**Coincidence Factor**

N/A

**Algorithm**

**Calculation of Energy Savings**

**Electric Energy Savings**

For facilities heated by natural gas,

∆kWh = Condition Space/1000 \* SFcooling

For facilities heated by heat pumps,

∆kWh = Condition Space/1000 \* SFcooling+ Condition Space/1000 \* SFHeat HP

For facilities heated by electric resistance,

∆kWh = Condition Space/1000 \* SFcooling+ Condition Space/1000 \* SFHeat ER

Where:

Conditioned Space = actual square footage of conditioned space controlled by sensor

SFcooling = Cooling Savings Factor

= value in table below based on building type and weather zone

SFHeat HP = Heating Savings factor for facilities heated by Heat Pump (HP)

= value in table below based on building type and weather zone

SFHeat ER = Heating Savings factor for facilities heated by Electric Resistance (ER)

= value in table below based on building type and weather zone

Saving Factor Tables[[3]](#footnote-4)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Building Type** | **SFcooling (kWh/1000 SqFt)** | | | | |
| **Zone 1 (Rockford)** | **Zone 2 (Chicago)** | **Zone 3 (Springfield)** | **Zone 4 (Belleville)** | **Zone 5 (Marion)** |
| Office - Low-rise | 454 | 456 | 460 | 456 | 462 |
| Office - Mid-rise | 430 | 431 | 432 | 428 | 433 |
| Office - High-rise | 448 | 450 | 452 | 449 | 454 |
| Religious Building | 493 | 509 | 573 | 584 | 605 |
| Restaurant | 505 | 515 | 553 | 569 | 581 |
| Retail - Department Store | 620 | 625 | 630 | 638 | 642 |
| Retail - Strip Mall | 380 | 376 | 356 | 406 | 407 |
| Convenience Store | 602 | 603 | 610 | 612 | 614 |
| Elementary School | 317 | 327 | 352 | 352 | 363 |
| High School | 305 | 316 | 340 | 340 | 352 |
| College/University | 392 | 410 | 434 | 449 | 462 |
| Healthcare Clinic | 353 | 358 | 379 | 383 | 389 |
| lodging | 576 | 578 | 586 | 588 | 591 |
| Manufacturing | 481 | 482 | 482 | 477 | 482 |
| Special Assembly Auditorium | 410 | 427 | 479 | 494 | 514 |
| Default | 451 | 458 | 475 | 482 | 490 |

| **Building Type** | **SF Heat HP (kWh/1000 SqFt)** | | | | |
| --- | --- | --- | --- | --- | --- |
| **Zone 1 (Rockford)** | **Zone 2 (Chicago)** | **Zone 3 (Springfield)** | **Zone 4 (Belleville)** | **Zone 5 (Marion)** |
| Office - Low-rise | 234 | 203 | 180 | 172 | 148 |
| Office - Mid-rise | 156 | 133 | 117 | 117 | 102 |
| Office - High-rise | 209 | 183 | 164 | 153 | 133 |
| Religious Building | 1,495 | 1,322 | 1,172 | 1,116 | 1,000 |
| Restaurant | 1,058 | 954 | 828 | 810 | 711 |
| Retail - Department Store | 365 | 326 | 289 | 283 | 250 |
| Retail - Strip Mall | 244 | 214 | 195 | 185 | 164 |
| Convenience Store | 179 | 161 | 141 | 137 | 117 |
| Elementary School | 652 | 567 | 500 | 470 | 414 |
| High School | 636 | 553 | 492 | 457 | 406 |
| College/University | 1,257 | 1,105 | 969 | 937 | 789 |
| Healthcare Clinic | 443 | 393 | 344 | 331 | 297 |
| lodging | 204 | 182 | 156 | 153 | 156 |
| Manufacturing | 166 | 145 | 125 | 120 | 109 |
| Special Assembly Auditorium | 1,759 | 1,551 | 1,399 | 1,366 | 1,202 |
| Default | 604 | 533 | 472 | 454 | 400 |

| **Building Type** | **SF Heat HP (kWh/1000 SqFt)** | | | | |
| --- | --- | --- | --- | --- | --- |
| **Zone 1 (Rockford)** | **Zone 2 (Chicago)** | **Zone 3 (Springfield)** | **Zone 4 (Belleville)** | **Zone 5 (Marion)** |
| Office - Low-rise | 703 | 610 | 539 | 516 | 445 |
| Office - Mid-rise | 467 | 399 | 352 | 352 | 305 |
| Office - High-rise | 627 | 549 | 492 | 458 | 399 |
| Religious Building | 4,486 | 3,966 | 3,517 | 3,348 | 3,001 |
| Restaurant | 3,175 | 2,862 | 2,485 | 2,429 | 2,134 |
| Retail - Department Store | 1,094 | 979 | 868 | 848 | 750 |
| Retail - Strip Mall | 732 | 641 | 586 | 554 | 492 |
| Convenience Store | 537 | 484 | 422 | 410 | 352 |
| Elementary School | 1,956 | 1,701 | 1,501 | 1,409 | 1,243 |
| High School | 1,908 | 1,659 | 1,477 | 1,372 | 1,219 |
| College/University | 3,770 | 3,314 | 2,907 | 2,810 | 2,368 |
| Healthcare Clinic | 1,330 | 1,179 | 1,032 | 992 | 891 |
| lodging | 611 | 546 | 469 | 458 | 469 |
| Manufacturing | 499 | 436 | 375 | 359 | 328 |
| Special Assembly Auditorium | 5,276 | 4,652 | 4,197 | 4,099 | 3,606 |
| Default | 1,811 | 1,598 | 1,415 | 1,361 | 1,200 |



For example: 7,500 SqFt of low-rise office space in Chicago with gas heat.

ΔkWh = 7,500 /1000 \*456

= 3,420 kWh

**Summer Coincident Peak Demand Savings**

NA

**Natural Gas Savings**

∆therms = Condition Space/1000 \* SF Heat Gas

Where:

SF Heat Gas = value in table below based on building type and weather zone[[4]](#footnote-5)

| **Building Type** | **SFHeat Gas (Therm/1000 sq ft)** | | | | |
| --- | --- | --- | --- | --- | --- |
| **Zone 1**  **(Rockford)** | **Zone 2**  **(Chicago)** | **Zone 3**  **(Springfield)** | **Zone 4**  **(Belleville)** | **Zone 5**  **(Marion)** |
| Office - Low-rise | 30 | 26 | 23 | 22 | 19 |
| Office - Mid-rise | 20 | 17 | 15 | 15 | 13 |
| Office- High-rise | 27 | 23 | 21 | 20 | 17 |
| Religious BuiIding | 191 | 169 | 150 | 143 | 128 |
| Restaurant | 135 | 122 | 106 | 104 | 91 |
| RetaiI - Department Store | 47 | 42 | 37 | 36 | 32 |
| Retail - Strip Mall | 31 | 27 | 25 | 24 | 21 |
| Convenience Store | 23 | 21 | 18 | 17 | 15 |
| Elementary School | 83 | 73 | 64 | 60 | 53 |
| High School | 81 | 71 | 63 | 59 | 52 |
| College/ University | 161 | 141 | 124 | 120 | 101 |
| Healthcare Clinic | 57 | 50 | 44 | 42 | 38 |
| Lodging | 26 | 23 | 20 | 20 | 20 |
| Manufacturing | 21 | 19 | 16 | 15 | 14 |
| Special Assembly Auditorium | 225 | 198 | 179 | 175 | 154 |
| De-fault | 77 | 68 | 60 | 58 | 51 |

For example: 7500 SqFt of low-rise office space in Chicago.

ΔTherms = 7,500 \* 26

= 195 Therms

**Water Impact Descriptions and Calculation**

N/A

**Deemed O&M Cost Adjustment Calculation**

N/A

**Measure code: CI-HVC-DCV-V03-160601**

1. During the course of conversations with vendors and Building Automation System (BAS) contractors, it was determined that sensors have to be functional for up to 10 years. It is recommended that they are part of a normal preventive maintenance program in which calibration is an important part of extending useful life. Although they are not subject to mechanical failure, they do fall out of tolerance over time. [↑](#footnote-ref-1)
2. Discussion with vendors [↑](#footnote-ref-2)
3. The electric energy savings was calculated using TMY3 weather data and methodology consistent with ASHRAE standards. Savings are calculated on an annual basis for each given temperature zone in Illinois. Energy savings for DCV were developed utilizing standards, inputs and approaches as set forth by ASHRAE 62.1and 90.1, respectively. Building input parameters like square footage, equipment efficiencies and occupancy match those used in the EFLH calculations. Reference calculation found in Demand Control Ventilation 12-30-13.xls. [↑](#footnote-ref-4)
4. The natural gas energy savings was calculated using TMY3 weather data and methodology consistent with ASHRAE standards. Savings are calculated on an annual basis for each given temperature zone in Illinois. Energy savings for DCV were developed utilizing standards, inputs and approaches as set forth by ASHRAE 62.1 and 90.1, respectively. Building input parameters like square footage, equipment efficiencies and occupancy match those used in the EFLH calculations. Reference calculation found in Demand Control Ventilation 12-30-13.xls. [↑](#footnote-ref-5)