

# The Varennes Library



Presentation of the design  
process for the  
mechanical and  
the electrical

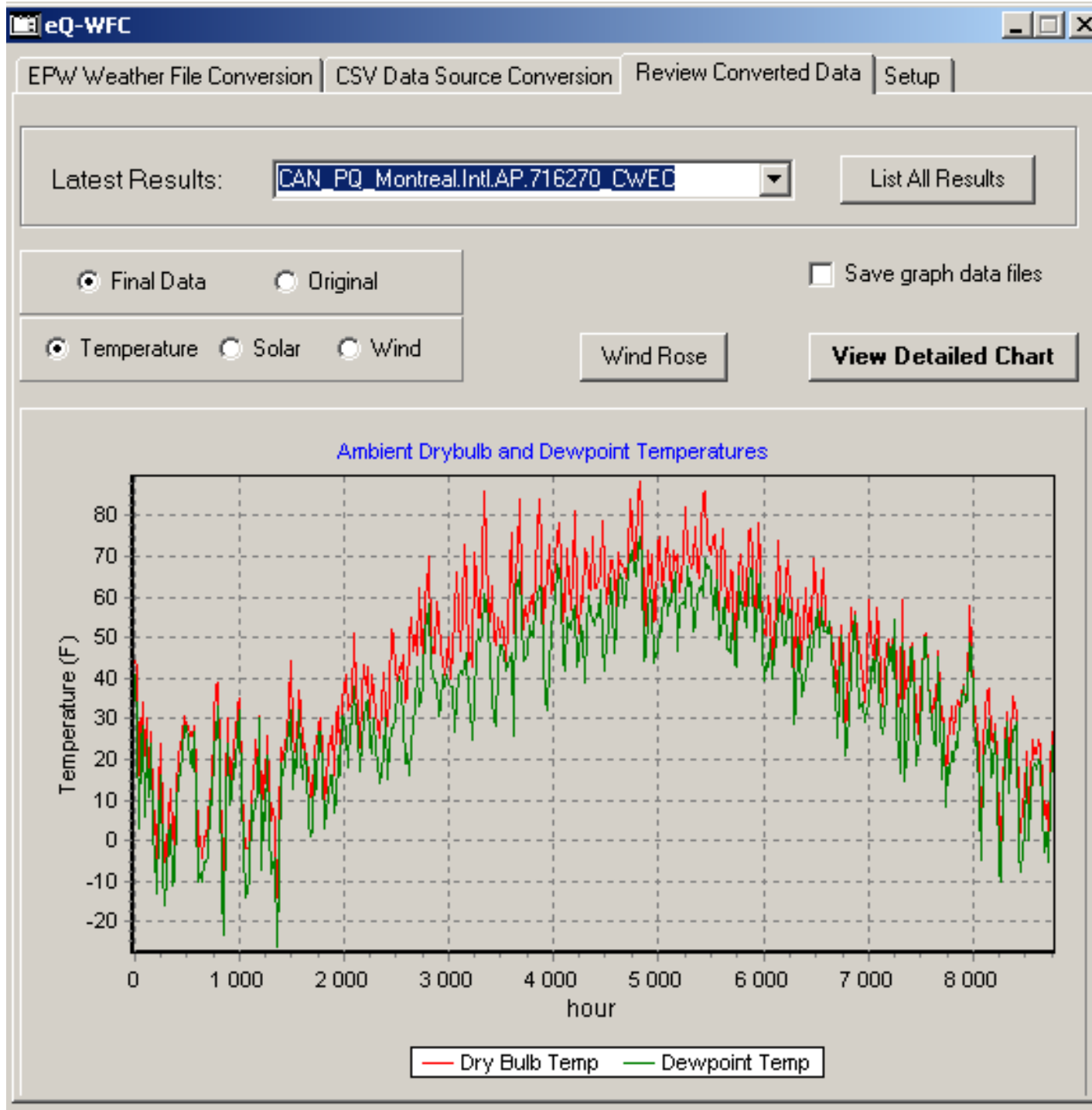


November 16, 2016

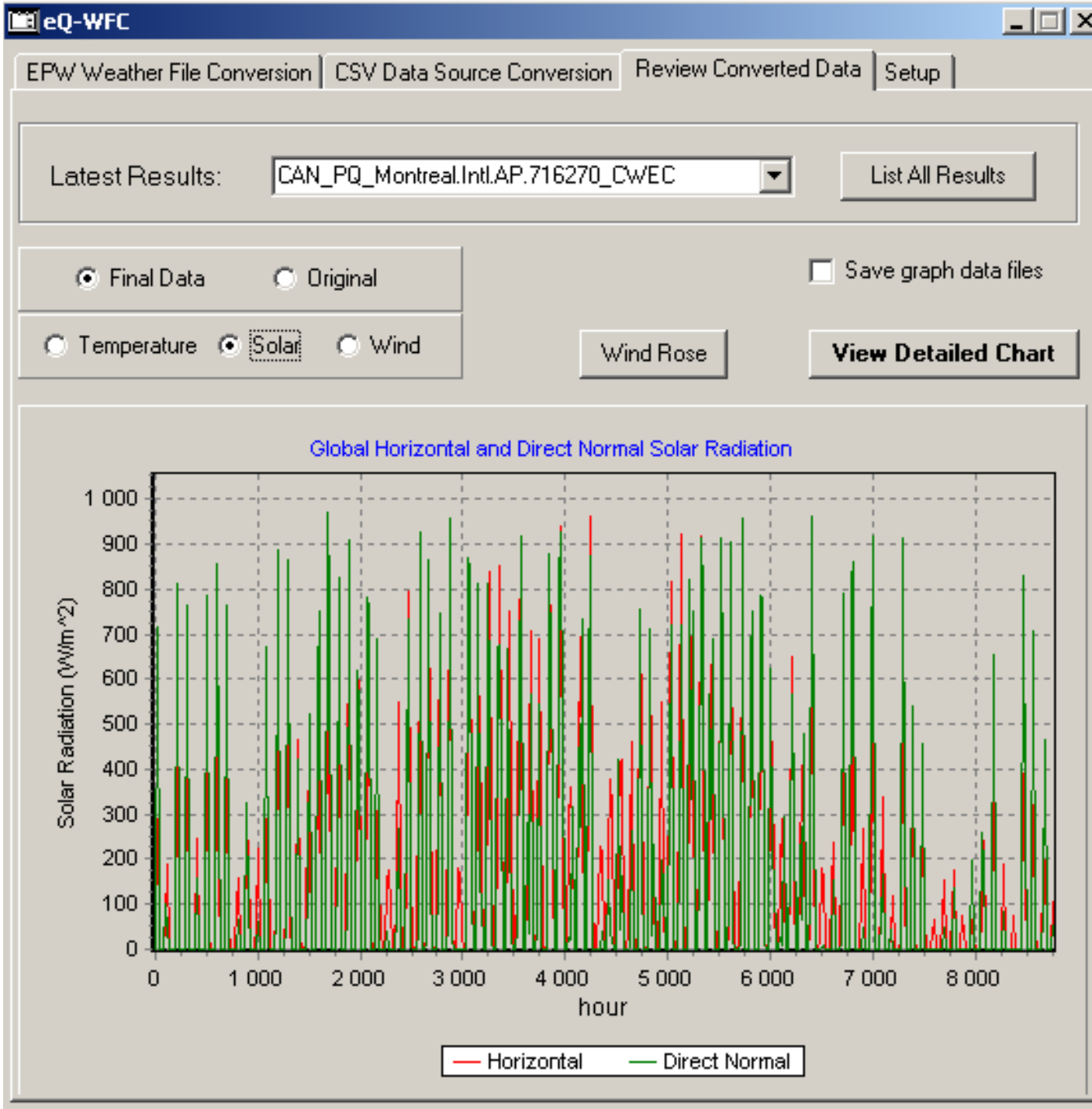
Labbé, Laroche / Gagné, Leclerc et Associés



Canadian Consulting Engineering Award



Weather  
file used :  
  
CWEC  
for  
Montréal



Weather  
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CWEC  
for  
Montréal

# Characteristic of the zones (maximum value)

Bibliothèque de Varennes  
Dessau

Proposed

REPORT- LV-B SUMMARY OF SPACES OCCURRING IN THE PROJECT

DOE-2.1E-133 4/15/2012 15:21:08 LDL RUN 1  
Fonction de l'espace  
WEATHER FILE- Montreal Que CWEC

| NUMBER OF SPACES |                           | EXTERIOR      |         | INTERIOR                      |        |                            |                        |                         |                 |                   |
|------------------|---------------------------|---------------|---------|-------------------------------|--------|----------------------------|------------------------|-------------------------|-----------------|-------------------|
| SPACE            | SPACE*FLOOR<br>MULTIPLIER | SPACE<br>TYPE | AZIMUTH | LIGHTING<br>(WATT /<br>SQFT ) | PEOPLE | EQUIP<br>(WATT /<br>SQFT ) | INFILTRATION<br>METHOD | AIR CHANGES<br>PER HOUR | AREA<br>(SQFT ) | VOLUME<br>(CUFT ) |
| ZONE-1           | 1.0                       | EXT           | 0.0     | 0.13                          | 0.6    | 0.09                       | AIR-CHANGE             | 0.23                    | 1164.00         | 11636.00          |
| ZONE-2           | 1.0                       | EXT           | 0.0     | 0.39                          | 0.4    | 0.45                       | AIR-CHANGE             | 0.35                    | 819.00          | 8192.00           |
| ZONE-3           | 1.0                       | EXT           | 0.0     | 0.46                          | 25.9   | 0.45                       | AIR-CHANGE             | 0.33                    | 1400.00         | 14004.00          |
| ZONE-4           | 1.0                       | EXT           | 0.0     | 0.46                          | 10.7   | 0.45                       | AIR-CHANGE             | 0.41                    | 580.00          | 5802.00           |
| ZONE-5           | 1.0                       | EXT           | 0.0     | 0.46                          | 9.5    | 0.45                       | AIR-CHANGE             | 0.34                    | 2045.00         | 20452.00          |
| ZONE-6           | 1.0                       | EXT           | 0.0     | 0.46                          | 7.2    | 0.45                       | AIR-CHANGE             | 0.46                    | 388.00          | 3875.00           |
| ZONE-7           | 1.0                       | INT           | 0.0     | 0.65                          | 11.5   | 0.45                       | AIR-CHANGE             | 0.00                    | 3103.00         | 31033.00          |
| ZONE-8           | 1.0                       | INT           | 0.0     | 0.65                          | 5.1    | 0.45                       | AIR-CHANGE             | 0.00                    | 1379.00         | 13789.00          |
| ZONE-9           | 1.0                       | EXT           | 0.0     | 0.39                          | 14.6   | 0.45                       | AIR-CHANGE             | 0.25                    | 786.00          | 7858.00           |
| ZONE-10          | 1.0                       | EXT           | 0.0     | 0.46                          | 25.7   | 0.45                       | AIR-CHANGE             | 0.24                    | 1389.00         | 13886.00          |
| ZONE-11          | 1.0                       | EXT           | 0.0     | 0.46                          | 10.8   | 0.45                       | AIR-CHANGE             | 0.61                    | 581.00          | 5813.00           |
| ZONE-12          | 1.0                       | EXT           | 0.0     | 0.46                          | 24.5   | 0.45                       | AIR-CHANGE             | 0.24                    | 1324.00         | 13240.00          |
| ZONE-13          | 1.0                       | EXT           | 0.0     | 0.46                          | 8.7    | 0.45                       | AIR-CHANGE             | 0.23                    | 747.00          | 7467.00           |
| ZONE-14          | 1.0                       | EXT           | 0.0     | 0.46                          | 10.8   | 0.45                       | AIR-CHANGE             | 0.61                    | 581.00          | 5813.00           |
| ZONE-15          | 1.0                       | EXT           | 0.0     | 0.46                          | 9.3    | 0.45                       | AIR-CHANGE             | 0.00                    | 3017.00         | 30172.00          |
| ZONE-16          | 1.0                       | EXT           | 0.0     | 0.46                          | 7.3    | 0.45                       | AIR-CHANGE             | 0.00                    | 1565.00         | 15651.00          |
| SYSTEM-1-DUMMY   | 1.0                       | INT           | 0.0     | 0.00                          | 0.0    | 0.00                       | AIR-CHANGE             | 0.00                    | 1.00            | 15.00             |
| BUILDING TOTALS  |                           |               |         |                               | 182.6  |                            |                        |                         | 20869.00        | 208698.00         |

# Overview of the area of walls and roofs

Bibliothèque de Varennes  
 Dessau  
 REPORT- LV-D DETAILS OF EXTERIOR SURFACES IN THE PROJECT

Proposed

DOE-2.1Ecl33 4/15/2012 22:36:25 LDL RUN 1  
 Fonction de l'espace  
 WEATHER FILE- Montreal Que CWEC

(CONTINUED)

|             | AVERAGE<br>U-VALUE/WINDOWS<br>(BTU/HR-SQFT-F) | AVERAGE<br>U-VALUE/WALLS<br>(BTU/HR-SQFT-F) | AVERAGE U-VALUE<br>WALLS+WINDOWS<br>(BTU/HR-SQFT-F) | WINDOW<br>AREA<br>(SQFT) | WALL<br>AREA<br>(SQFT) | WINDOW+WALL<br>AREA<br>(SQFT) |
|-------------|---|---|---|--------------------------|------------------------|-------------------------------|
| NORTH       | 0.205   | 0.022                                       | 0.040   | 385.56                   | 3573.56                | 3959.12                       |
| EAST        | 0.205   | 0.022                                       | 0.082   | 641.61                   | 1327.19                | 1968.80                       |
| SOUTH       | 0.324   | 0.022                                       | 0.127   | 1662.17                  | 3139.83                | 4802.00                       |
| WEST        | 0.205   | 0.022                                       | 0.069   | 546.90                   | 1605.98                | 2152.88                       |
| FLOOR       | 0.000   | 0.022                                       | 0.022   | 0.00                     | 486.64                 | 486.64                        |
| ROOF        | 0.205   | 0.017                                       | 0.020   | 241.12                   | 12278.13               | 12519.25                      |
| ALL WALLS   | 0.266   | 0.022                                       | 0.083   | 3236.23                  | 9646.57                | 12882.80                      |
| WALLS+ROOFS | 0.262   | 0.019                                       | 0.052   | 3477.35                  | 21924.70               | 25402.05                      |
| UNDERGRND   | 0.000   | 0.163                                       | 0.163   | 0.00                     | 11454.25               | 11454.25                      |
| BUILDING    | 0.262   | 0.068                                       | 0.086   | 3477.35                  | 33865.59               | 37342.94                      |

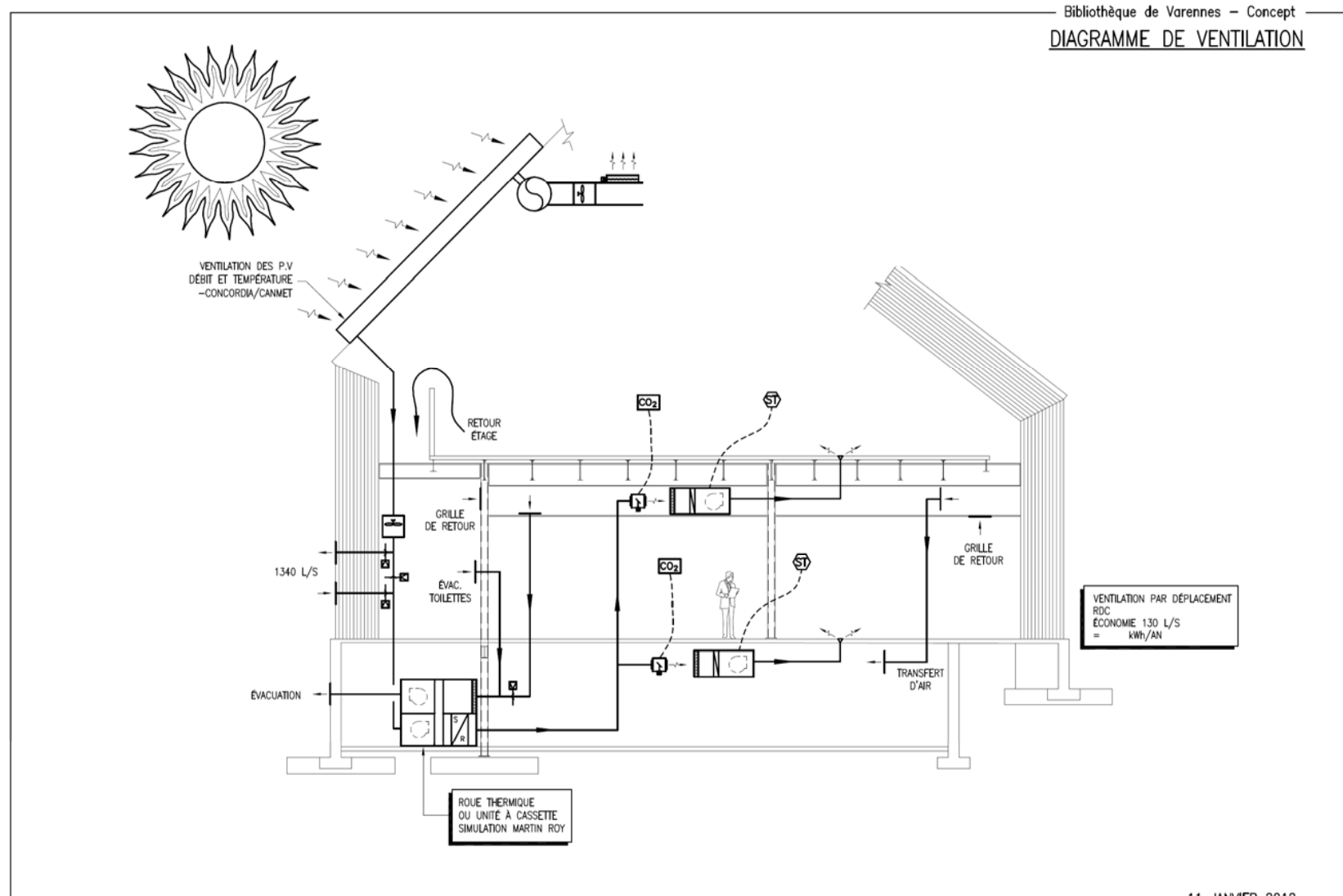
# Characteristics of the loads for one zone

| TIME                       | COOLING LOAD   |  |          |  | HEATING LOAD  |  |         |  |
|----------------------------|----------------|--|----------|--|---------------|--|---------|--|
|                            | OCT 11         |  | 3PM      |  | FEB 4         |  | 9AM     |  |
| DRY-BULB TEMP              | 73 F           |  | 23 C     |  | -12 F         |  | -24 C   |  |
| WET-BULB TEMP              | 59 F           |  | 15 C     |  | -13 F         |  | -25 C   |  |
| TOT HORIZONTAL SOLAR RAD   | 162 BTU/H.SQFT |  | 510 W/M2 |  | 19 BTU/H.SQFT |  | 59 W/M2 |  |
| WINDSPEED AT SPACE         | 2.0 KTS        |  | 1.0 M/S  |  | 11.4 KTS      |  | 5.9 M/S |  |
| CLOUD AMOUNT 0 (CLEAR) -10 | 1              |  |          |  | 7             |  |         |  |

|                       | SENSIBLE         |        | LATENT       |        | SENSIBLE          |        |             |
|-----------------------|------------------|--------|--------------|--------|-------------------|--------|-------------|
|                       | (KBTU/H)         | ( KW ) | (KBTU/H)     | ( KW ) | (KBTU/H)          | ( KW ) |             |
| WALL CONDUCTION       | -0.015           | -0.004 | 0.000        | 0.000  | -0.371            | -0.109 |             |
| ROOF CONDUCTION       | 0.057            | 0.017  | 0.000        | 0.000  | -1.931            | -0.566 |             |
| WINDOW GLASS+FRM COND | -1.923           | -0.563 | 0.000        | 0.000  | -23.880           | -6.997 |             |
| WINDOW GLASS SOLAR    | 47.766           | 13.995 | 0.000        | 0.000  | 1.123             | 0.329  |             |
| DOOR CONDUCTION       | 0.000            | 0.000  | 0.000        | 0.000  | 0.000             | 0.000  |             |
| INTERNAL SURFACE COND | 0.000            | 0.000  | 0.000        | 0.000  | 0.000             | 0.000  |             |
| UNDERGROUND SURF COND | 0.000            | 0.000  | 0.000        | 0.000  | 0.000             | 0.000  |             |
| OCCUPANTS TO SPACE    | 1.385            | 0.406  | 1.209        | 0.354  | 0.111             | 0.033  |             |
| LIGHT TO SPACE        | 1.500            | 0.439  | 0.000        | 0.000  | 0.223             | 0.065  |             |
| EQUIPMENT TO SPACE    | 1.736            | 0.509  | 0.000        | 0.000  | 0.187             | 0.055  |             |
| PROCESS TO SPACE      | 0.000            | 0.000  | 0.000        | 0.000  | 0.000             | 0.000  |             |
| INFILTRATION          | -0.059           | -0.017 | 0.000        | 0.000  | -5.053            | -1.481 |             |
| TOTAL                 | 50.447           | 14.781 | 1.209        | 0.354  | -29.590           | -8.670 |             |
| TOTAL / AREA          | 0.036            | 0.115  | 0.001        | 0.003  | -0.021            | -0.067 |             |
| TOTAL LOAD            | 51.656 KBTU/H    |        | 15.135 KW    |        | -29.590 KBTU/H    |        | -8.670 KW   |
| TOTAL LOAD / AREA     | 37.19 BTU/H.SQFT |        | 117.288 W/M2 |        | 21.303 BTU/H.SQFT |        | 67.187 W/M2 |

# Graphic representation for the geothermal option

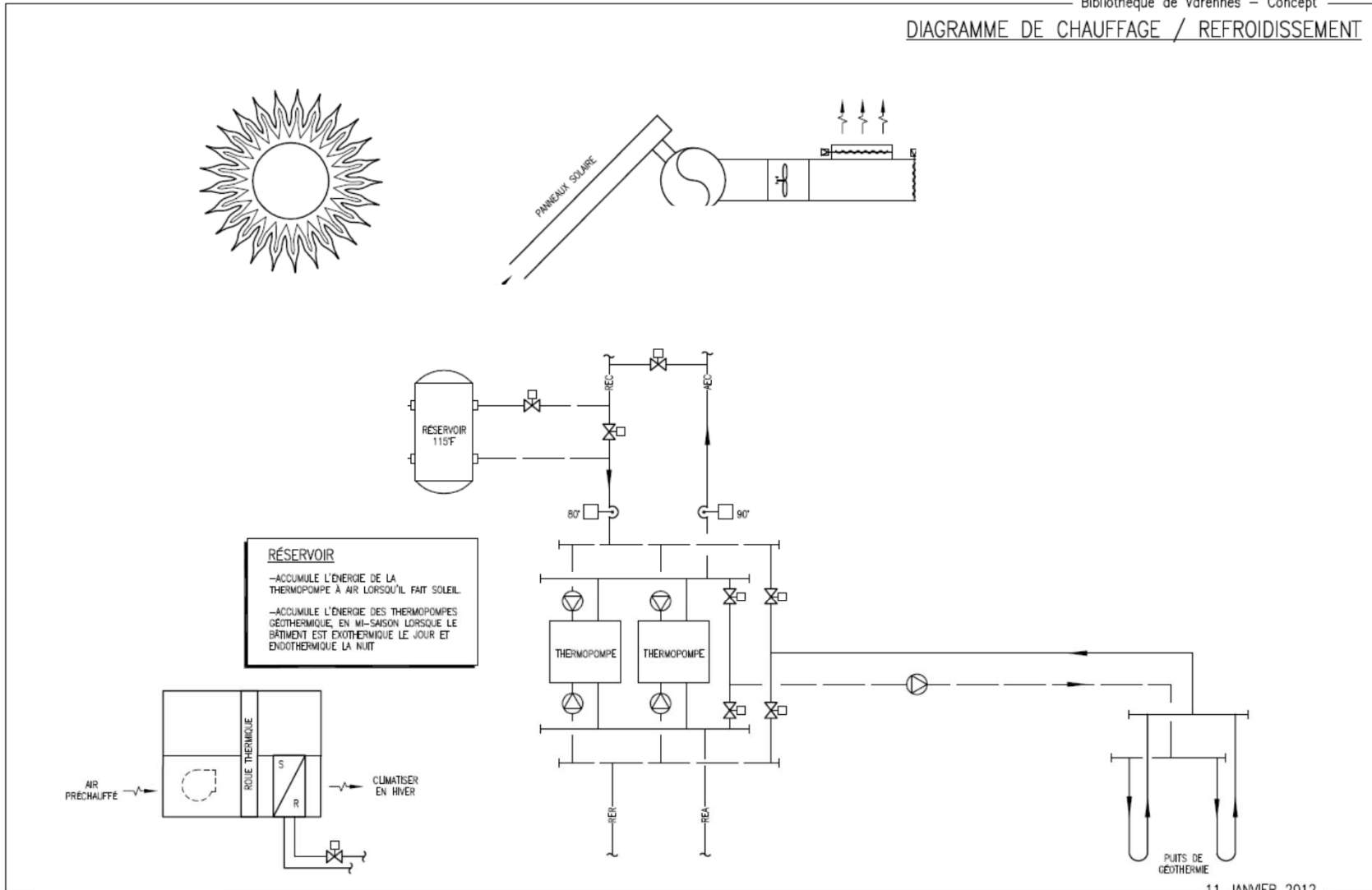




# Graphic representation for the geothermal option

Bibliothèque de Varennes – Concept

DIAGRAMME DE CHAUFFAGE / REFROIDISSEMENT



# Geothermal contribution to the heating loads

| AR20 |                            |        |   | fx =AF20+AO20+AP20       |    |  |    |   |    |                         |                               |  |          |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
|------|----------------------------|--------|---|--------------------------|----|--|----|---|----|-------------------------|-------------------------------|--|----------|---|----|---------------|----|---|--|----------------------------|--|---|--|--|--|--------------------------------|--|--------------------------------------|--|--|--|---------------------|--|
| A    | B                          | C      | D | AF                       | AG | AH   | AI | AJ                                      | AK | AL                      | AM                            | AN   | AO       | AP  | AQ | AR            | AS |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 1    | DESSAU                     | CLIENT |   |                          |    |  |    |   |    |                         |                               |  |          |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 2    |                            | PROJ   |   |                          |    |  |    |   |    |                         |                               |  |          |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 3    |                            | SUJET  |   |                          |    |  |    |   |    |                         |                               |  | 4 373,18 |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 4    |                            | chauff |   |                          |    |  |    |   |    |                         |                               |  |          |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 5    |                            |        |   |                          |    |  |    |   |    |                         |                               |  |          |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 6    |                            |        |   |                          |    |  |    |   |    |                         |                               |  |          |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 7    |                            |        |   |                          |    |  |    |   |    |                         |                               |  |          |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 8    |                            |        |   |                          |    |  |    |   |    |                         |                               |  |          |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 10   | P042305 - Bibliothèque de  |        |   | Pompe eau-chauffée       |    | 60,00 usgpm  |    | Eau chaude                              |    | Capacité de             |                               | COP  |          | Chauffage                                       |    | appoint       |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 11   | Fichier météo Montréal C   |        |   | Perte de Pression        |    | 60,00 ft   |    | include                                 |    | Chauffage [kW]          |                               |  |          |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 12   | VarenPS_08_MC.inp          |        |   | 23 EER chiller d'appoint |    | 17,50  |    | 0,97                                    |    | 0                       |                               | 68   |          | 5,20  |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 13   | CHAUFFAGE & SES POMPES     |        |   |                          |    |  |    |   |    |                         | PAC - géothermie en chauffage |  |          |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 14   | VALEUR MINIMUM             |        |   | 0,00                     |    | 0,00   |    | 0,00                                    |    | 0,00                    |                               | 0  |          | 0,00  |    | 0,00          |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 15   | VALEUR MAXIMUM             |        |   | 3,26                     |    | 11,06  |    | 0,00                                    |    | 91,69                   |                               | 0,97   |          | 0,00  |    | 90,72         |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 16   | SOMME DES VALEURS          |        |   | 1 568                    |    | 6 944  |    | 0                                       |    | 81 213,04               |                               | 2 755,10                                     |          | 0,00  |    | 79 541,17     |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 17   | Facteur d'aire de bâtiment |        |   | 1                        |    | Consom. énerg Chiller eau-eau portion recup (gains internes) |    | Consom. énerg Chiller eau-eau (cooling) |    | énerg appoint (cooling) |                               | Besoins en chauffage (enveloppe + air frais) |          | Énergie de la pompe transférer à l'eau chauffée |    | Chauffage ECD |    | Besoin de chauffage avant apport du chiller |  | Chauffage total nécessaire |  | Besoins de chauffage comblés par PAC géothermique |  | Consommation électrique de la PAC en chauffage |  | Besoins de chauffage résiduels |  | Consommation électrique en chauffage |  | Consommation électrique en refroidissement |  | Con électr Pum Equi |  |
| 18   | Utilisé                    |        |   |                          |    |  |    |   |    |                         |                               |  |          |   |    |               |    |   |  |                            |  |   |  |  |  |                                |  |                                      |  |  |  |                     |  |
| 19   | Heure MM DD HH             |        |   | [KW]                     |    | [KW]   |    | [KW]                                    |    | [KW]                    |                               | [KW]   |          | [KW]  |    | [KW]          |    | [KW]  |  | [KW]                       |  | [KW]  |  | [KW]   |  | [KW]                           |  | [KW]                                 |  | [KW]                                       |  |                     |  |
| 20   | 1 1 1 1                    |        |   | 0,12                     |    | 0,00   |    | 0,00                                    |    | 1,07                    |                               | 0,29   |          | 0,00  |    | 0,78          |    | 0,18  |  | 0,18                       |  | 0,04  |  | 0,00   |  | 0,15                           |  | 0,00                                 |  |  |  |                     |  |
| 21   | 2 1 1 2                    |        |   | 0,07                     |    | 0,04   |    | 0,00                                    |    | 0,68                    |                               | 0,29   |          | 0,00  |    | 0,39          |    | 0,00  |  | 0,00                       |  | 0,00  |  | 0,00   |  | 0,07                           |  | 0,04                                 |  |  |  |                     |  |
| 22   | 3 1 1 3                    |        |   | 0,33                     |    | 0,00   |    | 0,00                                    |    | 3,52                    |                               | 0,29   |          | 0,00  |    | 3,23          |    | 1,49  |  | 1,49                       |  | 0,29  |  | 0,00   |  | 0,62                           |  | 0,00                                 |  |  |  |                     |  |
| 23   | 4 1 1 4                    |        |   | 0,00                     |    | 0,12   |    | 0,00                                    |    | 0,00                    |                               | 0,29   |          | 0,00  |    | 0,00          |    | 0,00  |  | 0,00                       |  | 0,00  |  | 0,00   |  | 0,00                           |  | 0,12                                 |  |  |  |                     |  |
| 24   | 5 1 1 5                    |        |   | 0,33                     |    | 0,00   |    | 0,00                                    |    | 4,81                    |                               | 0,29   |          | 0,00  |    | 4,52          |    | 2,78  |  | 2,78                       |  | 0,53  |  | 0,00   |  | 0,87                           |  | 0,00                                 |  |  |  |                     |  |
| 25   | 6 1 1 6                    |        |   | 0,33                     |    | 0,00   |    | 0,00                                    |    | 5,10                    |                               | 0,29   |          | 0,00  |    | 4,81          |    | 3,07  |  | 3,07                       |  | 0,59  |  | 0,00   |  | 0,92                           |  | 0,00                                 |  |  |  |                     |  |
| 26   | 7 1 1 7                    |        |   | 0,33                     |    | 0,00   |    | 0,00                                    |    | 10,08                   |                               | 0,29   |          | 0,00  |    | 9,79          |    | 8,05  |  | 8,05                       |  | 1,55  |  | 0,00   |  | 1,88                           |  | 0,00                                 |  |  |  |                     |  |
| 27   | 8 1 1 8                    |        |   | 0,33                     |    | 0,00   |    | 0,00                                    |    | 38,88                   |                               | 0,41   |          | 0,00  |    | 38,47         |    | 36,73                                       |  | 36,73                      |  | 7,06  |  | 0,00   |  | 7,40                           |  | 0,00                                 |  |  |  |                     |  |
| 28   | 9 1 1 9                    |        |   | 0,44                     |    | 0,00   |    | 0,00                                    |    | 50,06                   |                               | 0,53   |          | 0,00  |    | 49,53         |    | 47,26                                       |  | 47,26                      |  | 9,09  |  | 0,00   |  | 9,53                           |  | 0,00                                 |  |  |  |                     |  |
| 29   | 10 1 1 10                  |        |   | 0,33                     |    | 0,00   |    | 0,00                                    |    | 46,62                   |                               | 0,49   |          | 0,00  |    | 46,13         |    | 44,39                                       |  | 44,39                      |  | 8,54  |  | 0,00   |  | 8,87                           |  | 0,00                                 |  |  |  |                     |  |

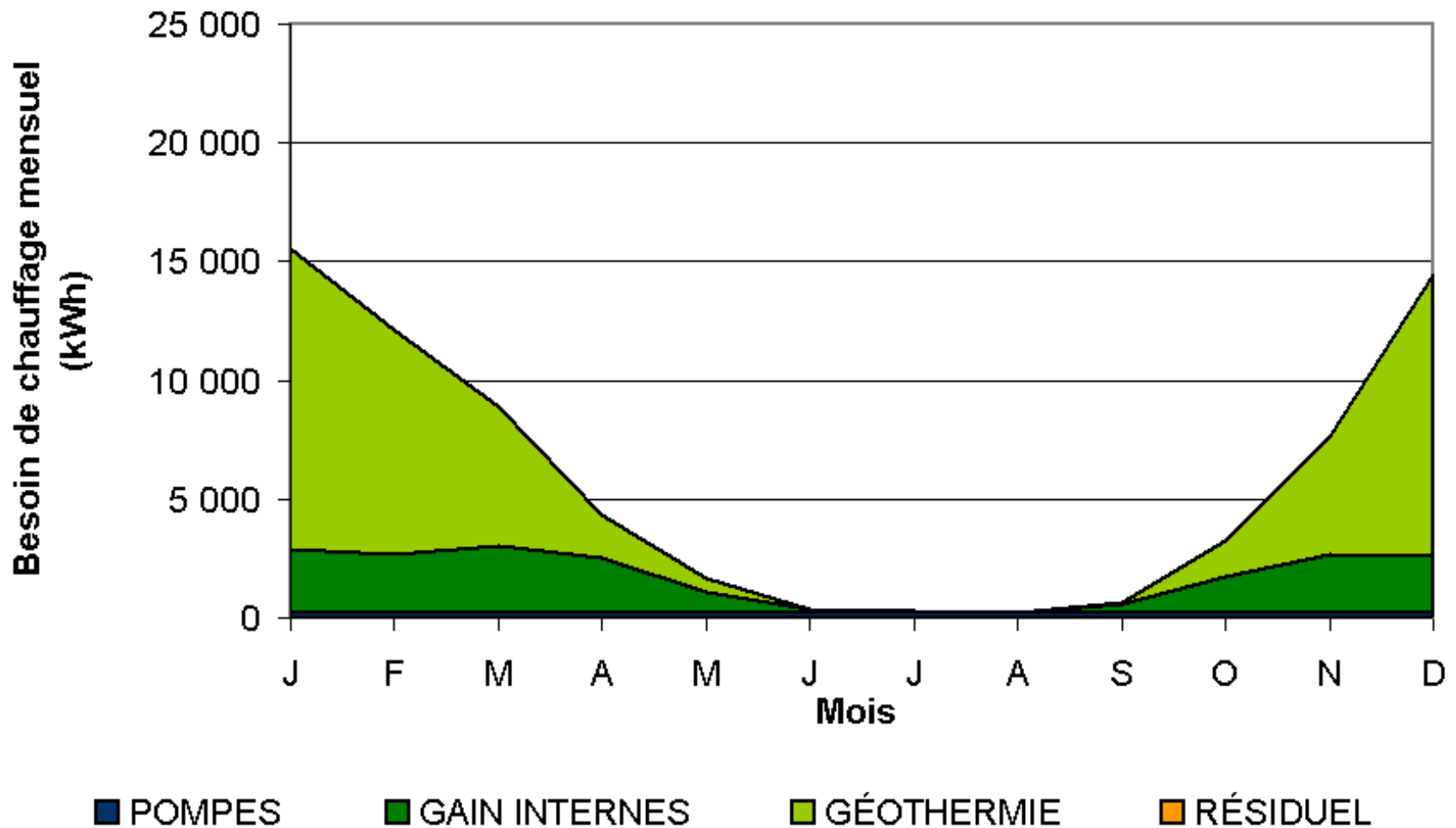
# Energy distribution for the geothermal option

Tableau 1. Consommation énergétique totale prévu pour le bâtiment

| MOIS         | Consommation énergétique totale pour le refroidissement (kwh) |               |               |              |              |               |              | Total          |   |
|--------------|---|---------------|---------------|--------------|--------------|---------------|--------------|----------------|---|
|              | ÉCLAIRAGE   | ÉQUIPEMENT    | ENTILATEUR    | U CHAUDE D   | POMPES       | CHAUFFAGE     | FROIDISSEME  |                |   |
| Janvier      | 2 615   | 1 407         | 2 550         | 964          | 709          | 3 590         | 22           | 11 856         | J |
| Février      | 2 344   | 1 260         | 2 295         | 871          | 622          | 2 806         | 21           | 10 218         | F |
| Mars         | 2 614   | 1 401         | 2 589         | 962          | 654          | 2 030         | 66           | 10 316         | M |
| Avril        | 2 448   | 1 318         | 2 565         | 897          | 622          | 966           | 415          | 9 230          | A |
| Mai          | 2 659   | 1 436         | 2 691         | 817          | 643          | 340           | 862          | 9 448          | M |
| Juin         | 2 363   | 1 291         | 2 624         | 684          | 637          | 32            | 1 657        | 9 289          | J |
| Juillet      | 2 437   | 1 334         | 2 716         | 625          | 688          | 12            | 2 461        | 10 272         | J |
| Août         | 2 506   | 1 373         | 2 682         | 623          | 675          | 6             | 2 105        | 9 970          | A |
| Septembre    | 2 456   | 1 324         | 2 612         | 653          | 628          | 90            | 865          | 8 628          | S |
| Octobre      | 2 615   | 1 407         | 2 626         | 752          | 644          | 634           | 448          | 9 126          | O |
| Novembre     | 2 546   | 1 364         | 2 389         | 802          | 631          | 1 755         | 86           | 9 573          | N |
| Décembre     | 2 516   | 1 355         | 2 435         | 923          | 701          | 3 336         | 21           | 11 288         | D |
| <b>Total</b> | <b>30 119</b>   | <b>16 269</b> | <b>30 774</b> | <b>9 574</b> | <b>7 853</b> | <b>15 596</b> | <b>9 028</b> | <b>119 214</b> |   |

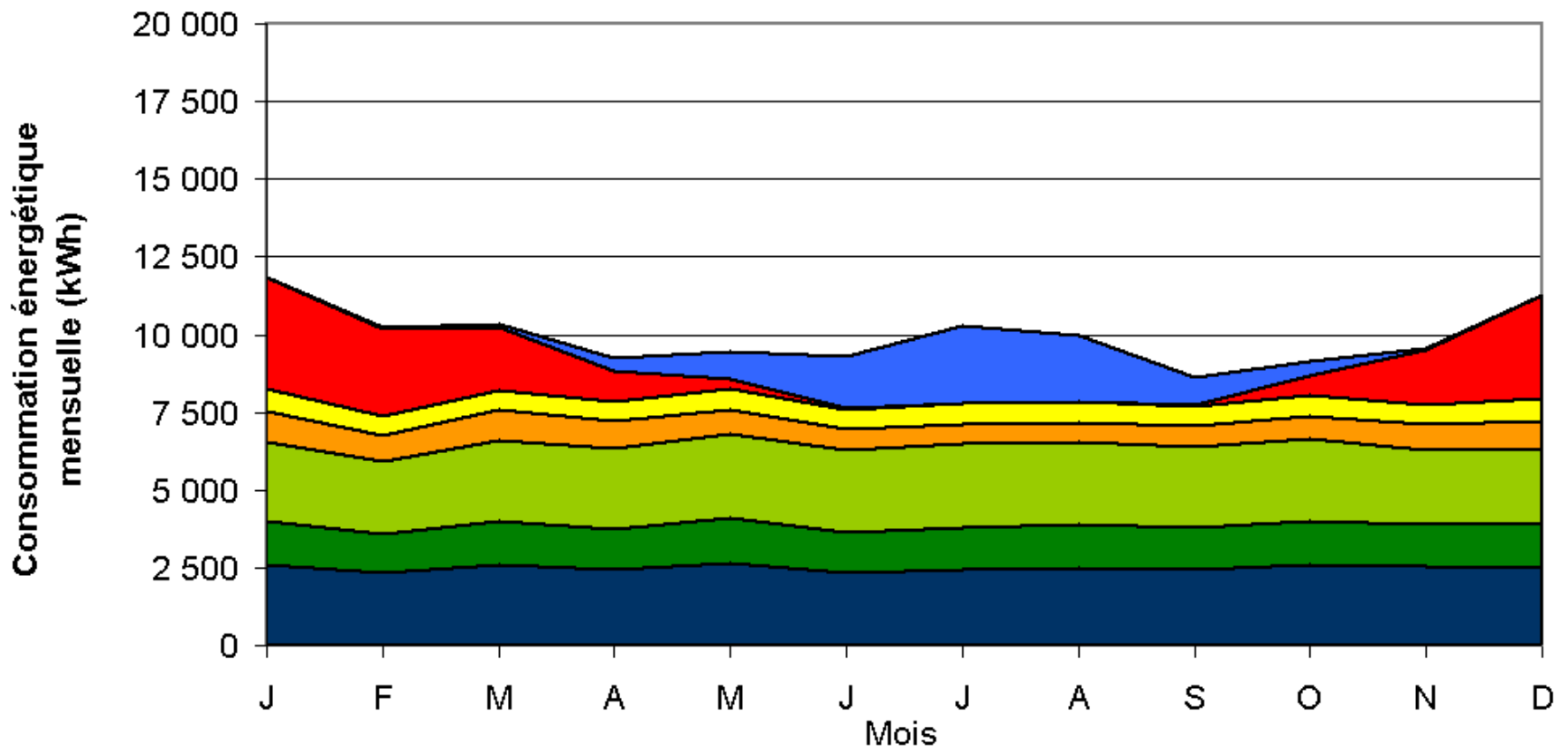
# Sources of heating with the geothermal system

Contribution des différentes sources au chauffage



# The several energy usage with the geothermal system

Consommation totale



■ ÉCLAIRAGE  
■ POMPES

■ ÉQUIPEMENT  
■ CHAUFFAGE

■ VENTILATEURS  
■ REFROIDISSEMENT

■ EAU CHAUDE DOM

# Monthly energy consumption and production with 650 m<sup>2</sup> of PV panels

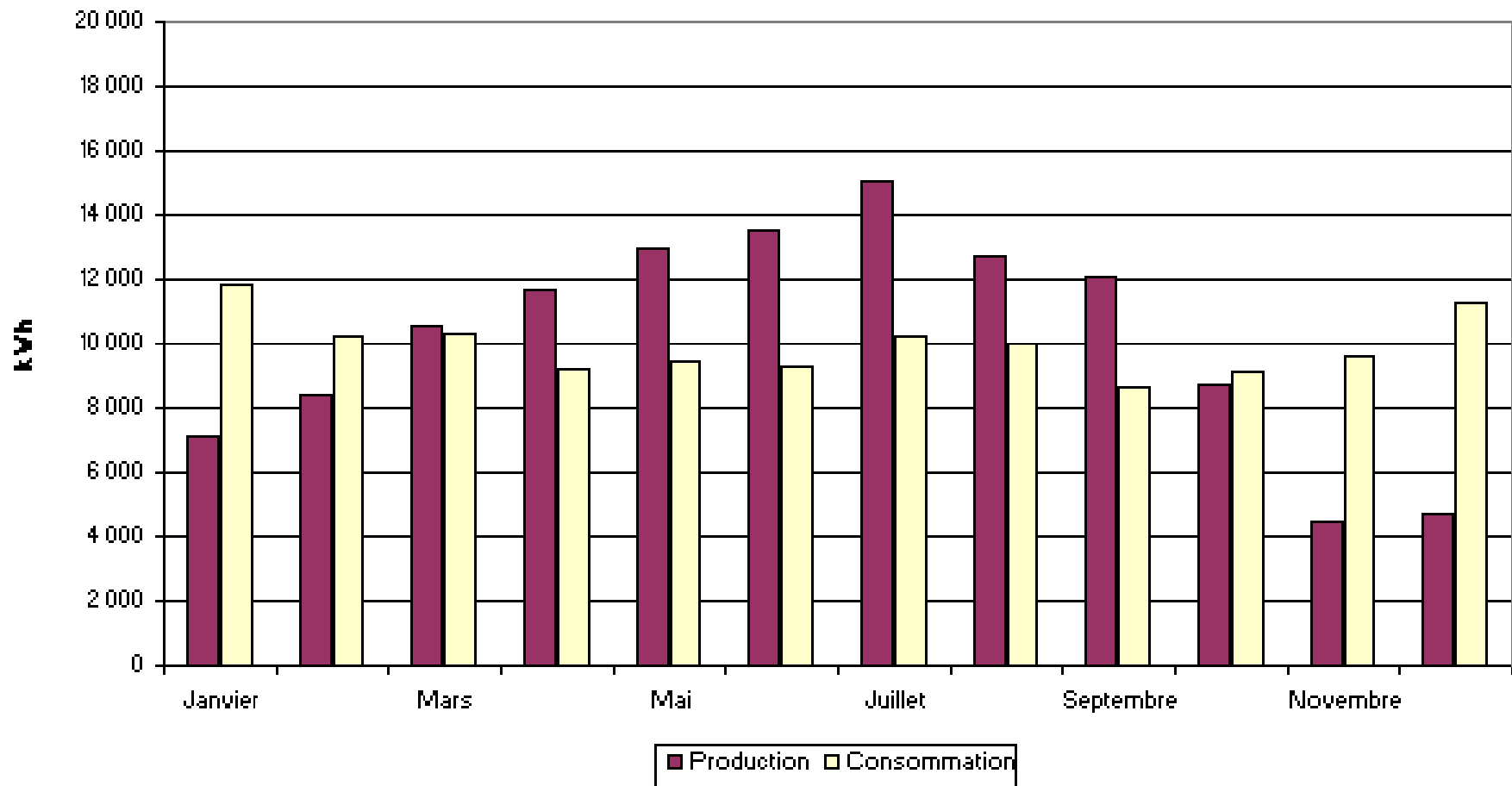
|  |  |  |                           |         |  |  |  |  |              |                |                     |
|--|--|--|---------------------------|---------|--|--|--|--|--------------|----------------|---------------------|
|  |  |  | Latitude =                | 45.47   |  |  |  |  |              |                |                     |
|  |  |  | Longitude =               | 73.75   |  |  |  |  |              | Photovoltaïque | Besoins électriques |
|  |  |  | Time Zone =               | -5      |  |  |  |  |              | kWh            | kWh                 |
|  |  |  |                           | Eastern |  |  |  |  | Janvier      | 7 119          | 11 856              |
|  |  |  | Local Standard Meridian = | 75      |  |  |  |  | Février      | 8 369          | 10 218              |
|  |  |  |                           |         |  |  |  |  | Mars         | 10 569         | 10 316              |
|  |  |  |                           |         |  |  |  |  | Avril        | 11 699         | 9 230               |
|  |  |  |                           |         |  |  |  |  | Mai          | 12 963         | 9 448               |
|  |  |  |                           |         |  |  |  |  | Juin         | 13 519         | 9 289               |
|  |  |  |                           |         |  |  |  |  | Juillet      | 15 069         | 10 272              |
|  |  |  |                           |         |  |  |  |  | Août         | 12 732         | 9 970               |
|  |  |  |                           |         |  |  |  |  | Septembre    | 12 093         | 8 628               |
|  |  |  |                           |         |  |  |  |  | Octobre      | 8 757          | 9 126               |
|  |  |  |                           |         |  |  |  |  | Novembre     | 4 487          | 9 573               |
|  |  |  |                           |         |  |  |  |  | Décembre     | 4 748          | 11 288              |
|  |  |  |                           |         |  |  |  |  | <b>TOTAL</b> | <b>122 126</b> | <b>119 214</b>      |

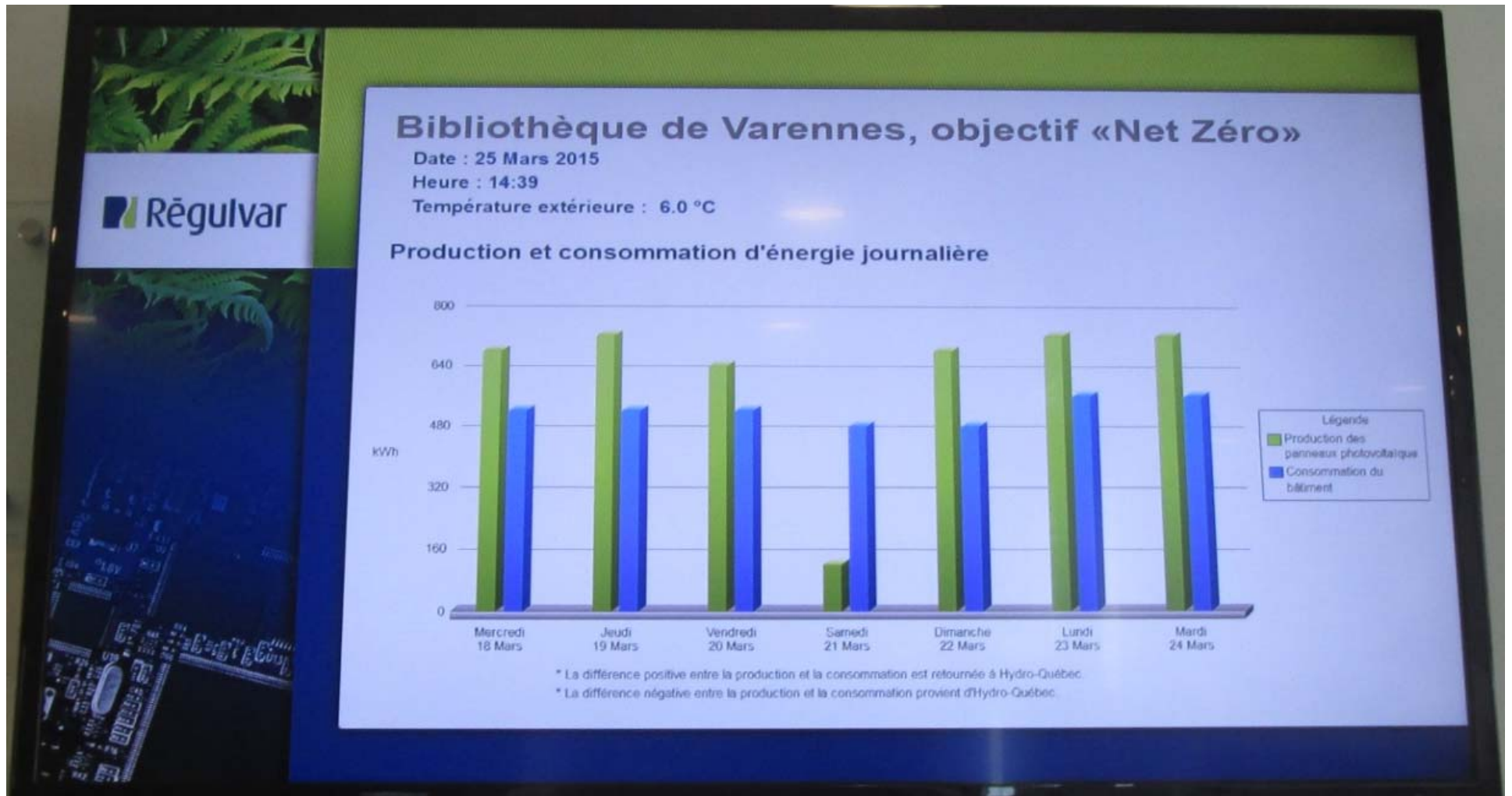
| Angle  | SHGC | Panneaux photovoltaïques |      |                |
|--------|------|--------------------------|------|----------------|
| 0      | 86%  | Efficacité               | 0.16 |                |
| 40     | 84%  | Surface                  | 650  | m2             |
| 50     | 82%  | $\psi$                   | 0    | degrees        |
| 60     | 78%  | $\Sigma$                 | 37   | degrees        |
| 70     | 67%  |                          | 1    | facteur diffus |
| 80     | 42%  |                          | 1    | IAC(diff)      |
| 90     | 0%   |                          | 1    | IAC(0)         |
| Hemis: | 78%  | SHGC                     | 1    | IAC(60)        |

# Monthly energy consumption and production with 650 m<sup>2</sup> of PV panels

Optimisation des panneaux solaires photovoltaïques pour électricité



# Graphic showing the actual performance





# Data on the actual performance

