SCCER Future Energy Efficient Buildings & Districts

Action area 1 “Efficiency”
Contract no. KTI.2014.0119

Deliverable Report

D37 Integration of data energy demand and renewable sources data
Update of GIS demand/supply web-service to version 1.3

Work package: 3, Task 3.1.3

Lead author: Stefan Schneider
Contributions: Dan Assouline, Nahid Mohajeri, Jean-Louis Scartezzini (EPFL-LESO)

Deliverable nature[1]	Report
Contractual delivery date	31.12.2016 (M43)
Actual delivery date	31.03.2018
Version	1.3
Total number of pages	28

[1] Prototype, report, demonstrator, other

1 Related milestone(s)

- M43, 12/2016, M40 12/2016

2 Summary

This task will consolidate results arising from tasks 3.1.1 and 3.1.2 (Geo-dependent energy supply and demand) within SCCER-FEEB&D as well as other SCCER projects. To reach this goal we plan to build a database fulfilling the following requirements:

- To deliver the results of our models estimating for energy supply and demand on a harmonized geographical aggregation level (commune level and 200 by 200m pixel size).
- To prepare a documentation about the delivered data.
- To provide easy and flexible access to data using a web-service.
- To publish on the HUES (Holistic Urban Energy Simulation**)** platform samples of scripts allowing querying this database.
- To provide scripts allowing to build a part of this database (heat demand).

The first release of the database contains rooftop PV potential (kWh) monthly and yearly values for each commune in Switzerland and yearly heat demand and electricity estimations. The database extends PV supply potential and heat demand estimations up to a resolution of 200 by 200m pixels. For electricity demand, the database contains for each Commune the yearly demand estimation decomposed into activities and appliances. Activities correspond to groups of NOGA codes within the industry & services sector. Appliances corresponds to the various possible usage of electricity as lightning, IT Entertaining, fridges, cooking. Appendix 5.2 lists the considered activities and appliances.

This report extends results of SCCER FEEB&D delivery report D36 (Schneider et al. 2015) and focuses on new delivered data.

For methodological aspects related to the models behind the construction of estimated demand data, please refer to the report (Schneider et al. 2016) and for rooftop solar PV potential refer to the report (Assouline, Mohajeri, and Scartezzini 2015). Forthcoming publications will focus on the methodology behind the electricity demand model elaborated in collaboration with collaboration with P. Le Strat responsible of the eco-21 program at Services Industriels de Genève (SIG).

2.1 Structure of the database

The table below lists the database tables used for data storage. Appendix 5.1 completes the description with a database diagram providing a full data dictionary. The Web-service described in the section 2.2 extracts data from from the following tables to build a XML SOAP (Simple Object Access Protocol) response. The (new) tag highlights functions added since delivery report D36.

Table name	Key fields	Description
SYS_WebserviceUser	*UserID*	Table containing user id and password to secure access. Please request logins at stefan.schneider@unige.ch
E_DEM_EConsumPerCommune	*bsf_id*	Estimated heated surface (m^2) and annual final energy demand for space heating and domestic hot water production (MJ). Estimations per communes, identified by the *bsf_id*.
E_DEM_EConsumPerPixel	*PixelSize, P_Xmin, P_Ymin*	Estimated heated surface (m^2) and annual final energy demand for space heating and domestic hot water production (MJ). Estimations for a pixel of territory of size *PixelSize* and with left down corner coordinates (CH_LV03) (*P_Xmin*, *P_Ymin*).

E_DEM_EHeat_ BootstrapConfIntervals	*PixelSize, P_Xmin, P_Ymin*	Confidence interval around estimated final energy demand and heated surface for confidence levels 90%, 95% and 99%.
(new) E_DEM_YearlyElecConsumPerCommune	*NoFedCommune, IDActivity, IDAppli-ance*	Contains yearly estimated electricity consumption per activity (Residential, Industry&Services,...) and appliances (lghting, fridges, heating, motor power...)
QGIS_ResidentsPerPixel	*PixelSize, P_Xmin, P_Ymin*	Number of permanent residents per pixel of *size PixelSize* of territory. (*P_Xmin, P_Ymin*) are the left down corner coordinates (CH_LV03) of the pixel.
QGIS_UrbanAeraCaracteristicts_VIEW	*NoFedCommune*	Surface occupied by urban areas within each commune are calculated based on CORINE Land Cover Switzerland (WSL). Contains also other characteristics as number of habitants, commune area in m^2 and so on.
E_RES_PVRessourceCommuneStatic	*NoFedCommune*	Solar rooftop PV potential estimated for each commune per year. The unit is kWh per year.
E_RES_PVRessourceCommunePerMonth	*NoFedCommune, MonthNumber*	Solar rooftop PV potential estimated for each commune per month. The unit is kWh per month.
(new) E_RES_PVRessourcePixelStatic	*P_Xmin, P_Ymin*	Solar rooftop PV potential estimated for each pixel size per year. The unit is kWh per year.
(new) E_RES_PVRessourcePixelPerMonth	*P_Xmin, P_Ymin, MonthNumber*	Solar rooftop PV potential estimated for each pixel size per month. The unit is kWh per month.

Table 1. List of tables in demand / supply database

2.2 Syntax for accessing database content

Web services are a standard way to publish a database content. This technique has the following advantages:

- Numerous libraries and samples in most programming environments are available to query data.
- The *web service description language* file (WSDL) contains a full description of this interface in a standardized form (XML format).
- Access over internet passes through the http port 80 without creating any security issues related to firewalls.

This service publishes a collection of functions giving access to data. Each function has arguments to specify the data request. Table 2 describes the syntax of these functions.

Function	**Arguments**	**SOAP object returned**
GetInformation	None	s:string : Version and copyright information and release number
GetSolarPVPotentialCommune Returns the solar rooftop PV potential for the selected commune. One value for a typical year and for each month is provided for each commune, Unit (kWh)	*userID, userPasswd*: authentication parameters to secure access *bsf_id*: Federal commune identifier. For example city of Zurich = 261	*PV_PotentialCommune* Object contain information as estimated yearly solar rooftop for each commune. Unit (kWh per year) and (kWh per month)
(new) *GetSolarPVPotentialPixel* Returns the solar PV potential for the 200 x 200 [m] pixels containing the	*userID, userPasswd*: authentication parameters to secure access *x_coord* : X coordinates in CHLV02 *y_coord* : Y coordinates in CHLV02 *PixelSize: 200 x 200m*	*PV_PotentialPixel:* Object contain information as estimated yearly solar rooftop for each pixel size. Unit (kWh per year) and (kWh per month)

required coordinate point. One value for a typical year and for each month is provided for each pixel. Unit (kWh)		
(new) *GetYearlyElectricityDemandCommune* Returns the estimated electricity consumption of the selected commune. Unit (MWh)	*userID*, *userPasswd*: authentication parameters to secure access *bsf_id*: Federal commune identifier. For example city of Zurich = 261 *SimulationYear*: Year of simulation: 2008, 2015, 2020, 2035, 2050 *DecompositionType*: Decomposition type of demand. Possible values are *ByActivity*, *ByAppliance*, *ByActivityAppliance*.	*ElectricityDemandCommune* : object containing the estimated yearly electricity consumption of the commune. Depending on the *DecompositionType* parameter, the service decomposes the demand by activity and / or by appliance. Appendix lists all activities and appliances. For more details, please refer to appendix 5.3.
GetHeatDemandCommune Returns aggregated yearly heat demand for the selected commune in (MJ/Year).	*userID*, *userPasswd*: authentication parameters to secure access *bsf_id*: Federal commune identifier. For example city of Zurich = 261	*HeatDemandCommune* : object containing information as estimated Yearly heat demand, estimated SRE, N b of buildings. For more details, please refer to appendix 5.3.
GetHeatDemandPixel Returns aggregated yearly heat demand for the pixel containing the required coordinate point in (MJ/Year).	*userID*, *userPasswd*: authentication parameters to secure access *x_coord* : X coordinates in CHLV02 *y_coord* : Y coordinates in CHLV02 *PixelSize* : Required size of pixel for the delivery of aggregated data (200, 400, 600, 1'000, 4'000, 16'000)	*HeatDemandPixel* : object containing information as estimated yearly heat demand, estimated SRE, Nb of buildings, confidence intervals for estimations. The pixel size is automatically increased until it contains at least four buildings. The response returns the chosen size that may differ with the parameter *PixelSize*. For more details, please refer to appendix 5.3.
GetHeatLoadCurvePixel Returns the estimated load-curve for the pixel defined by the coordinates of the paramters	*userID*, *userPasswd*: authentication parameters to secure access *x_coord* : X coordinates in CHLV02 *y_coord* : Y coordinates in CHLV02 *PixelSize* : Required size of pixel for the delivery of aggregated data. Values must be between 100 and 2'000 m. The upper left coordinates of the pixel are rounded up to 100m. *resticToResid*: if = 1 consider only residential buildings.	*HeatLoadCurve_Pixel*: object containing some static data for the pixel and the hourly estimated load curve for the selected Pixel for the year 2015.

Table 2. List of functions of web service

Appendix 5.3 provides sample of XML SOAP responses to describe in details each attribute of the returned data. On the HUES platform, samples of client code to query the web service are available at link https://hues.empa.ch/index.php/Data:Geo-dependent_energy_demand_and_supply_Web-Service

2.3 Available tools to build the database

The Swiss buildings GIS heat demand database allows building a database containing an estimation of the yearly final energy demand for space heating and domestic hot water production for each EGID of the Swiss Federal Building Register (Reg-BI). The module described in (Schneider 2016) provides scripts to create the database and the database tables, to load configuration data and to compute the estimated heat demand per building. The user of this database needs to make a contract with the Federal Office of

Statistics (BFS) to get a copy of the Reg-Bl. Once this data received, this module allows building a complete database. On the HUES platform, the module is available at link https://hues.empa.ch/index.php/Data:Swiss_buildings_GIS_heat_demand_database

3 Intellectual properties issues arising

The web service does not publish any data which could possibility break any confidential issues with the data contributors such as the Swiss Federal Statistical Office, Service Industriels de Genève, Swisstopo, and CECB. In addition, we do not consider this data as public. An authentication process restricts the access to the SCCER partners. The process as follows: A *UserID* is created by sending an email to stefan.schneider@unige.ch. All parties will sign a written non-disclosure agreement prior to delivery of user access.

The users of the data should cite the appropriate publications (reports/conference papers/journal papers) reporting the data and written by the people producing the data. Is not acceptable to cite only the websites or the name of institute (Geneva University and EPFL); the publications reporting the data must also be cited.

4 References

Assouline, Dan, Nahid Mohajeri, and Jean-Louis Scartezzini. 2015. "A Machine Learning Methodology for Estimating Roof-top Photovoltaic Solar Energy Potential in Switzerland." doi:10.5075/epfl-cisbat2015-555-560. https://doi.org/10.5075/epfl-cisbat2015-555-560.

Assouline Dan, Nahid Mohajeri, Jean-Louis Scartezzini. 2015b. Quantifying rooftop photovoltaic solar energy potential: A machine learning approach. *Accepted in Solar Energy*.

Mohajeri Nahid, Dan Assouline, Berenice Guiboud, Jean-Louis Scartezzini, 2016. Does roof shape matter? Solar energy integration on building roofs. *International Conference on Systems Thinking for the Built Environment, ETH Zurich June 13-17.*

Schneider, Stefan. 2016. *Swiss Buildings GIS Heat Demand Database, User Manual*. D37 Annex. SCCER FEEB&D Delivery Reports. UNIGE.

Schneider, Stefan, Dan Assouline, Nahid Mohajeri, and Jean-Louis Scartezzini. 2015. *Geo-dependent Energy Demand and Supply database:Structure, Syntax and Method of the Database.*D36. SCCER FEEB&D Delivery Reports. UNIGE and EPFL-LESO. http://wisesccer1.unige.ch/.

Schneider, Stefan, Jad Khoury, Bernard Lachal, and Pierre Hollmuller. 2016. "Geo-dependent Heat Demand Model of the Swiss Building Stock." *Sustainable Built Environment Regional Conference. SBE 2016, Zurich, June 15-17*, SBE Series 2016-17 edition.

5 Annexes

5.1 Database relational scheme

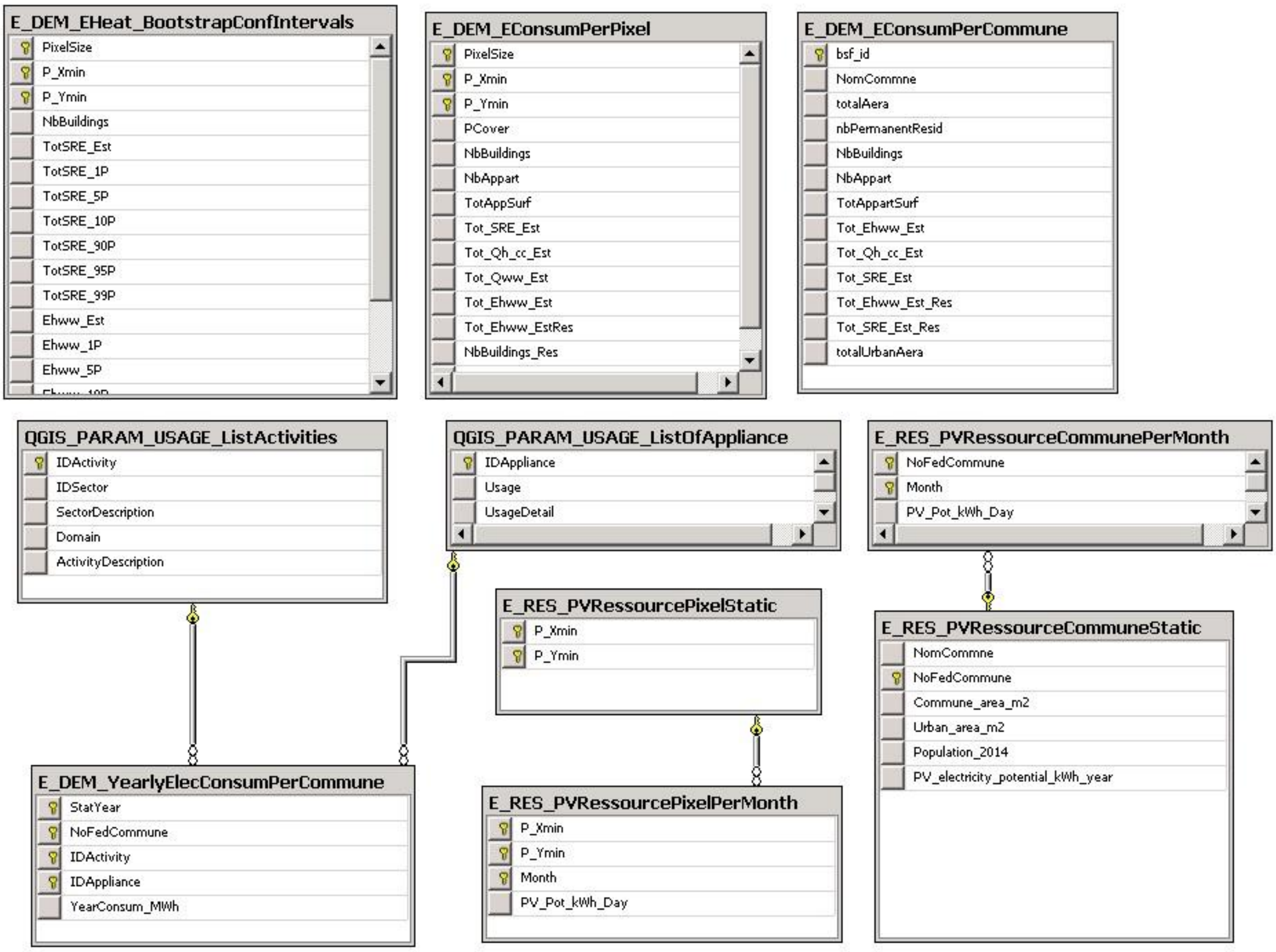

Figure 1. Database relational scheme

5.2 List of activities and appliances

IDActivity	IDSector	SectorDescription	ActivityDescription
1	1	Industry, chemistry, construction	Distribution and conditioning of water
2	1	Industry, chemistry, construction	Wastewater Collection and Treatment
3	1	Industry, chemistry, construction	Waste collection, treatment and disposal; recovery
4	1	Industry, chemistry, construction	Depollution and other waste management services
5	1	Industry, chemistry, construction	Production and distribution of electricity, gas, steam and air conditioning
6	1	Industry, chemistry, construction	Construction (Structural Work)
7	1	Industry, chemistry, construction	Other Manufacturing
8	1	Industry, chemistry, construction	Manufacture of computer, electronic, optical, electric
9	1	Industry, chemistry, construction	Printing and reproduction of recordings
10	1	Industry, chemistry, construction	Manufacture of other non-metallic mineral products
11	1	Industry, chemistry, construction	Manufacture of furniture
12	1	Industry, chemistry, construction	Manufacture and repair of machinery and equipment
13	1	Industry, chemistry, construction	Food industry, beverage, tobacco
14	1	Industry, chemistry, construction	Manufacture of other transport equipment
15	1	Industry, chemistry, construction	Automobile industry
16	1	Industry, chemistry, construction	Chemical industry
17	1	Industry, chemistry, construction	Pharmaceutical industry
18	1	Industry, chemistry, construction	Paper and paperboard industry
19	1	Industry, chemistry, construction	Extractive industry, cokefaction
20	1	Industry, chemistry, construction	Textile, clothing and leather industries
21	1	Industry, chemistry, construction	Manufacture of metal products, exept machinery and equipment
22	1	Industry, chemistry, construction	Metallurgy
23	1	Industry, chemistry, construction	Woodworking and wood products manufacturing, basketware
24	2	Residential	Residential Collective
25	2	Residential	Individual Residential
26	2	Residential	Secondary Residential
27	3	Administration and services	Financial activity and insurance
28	3	Administration and services	Real estate activities
29	3	Administration and services	Public administration and defense; Compulsory social security
30	3	Administration and services	Other
31	3	Administration and services	Administrative activities
32	3	Administration and services	Architectural and engineering activities; Control activities and analyzes
33	3	Administration and services	Rental and leasing activities
34	3	Administration and services	Activities of head offices; Board of management
35	3	Administration and services	Legal and accounting activities
36	3	Administration and services	Other specialized, scientific and technical activities
37	3	Administration and services	Programming, IT activities
38	3	Administration and services	Advertising and market research
39	3	Administration and services	Research-scientific development
40	3	Administration and services	Services related to buildings and landscaping
41	3	Administration and services	Trade
42	3	Administration and services	Repair of computers and personal property
43	3	Administration and services	Buildings
44	3	Administration and services	Activities of associations
45	3	Administration and services	Arts, Spectacles, Recreational Activities
46	3	Administration and services	edition
47	3	Administration and services	Production of cinematographic films, video
48	3	Administration and services	Programming and distribution
49	3	Administration and services	Information Services
50	3	Administration and services	Extra-territorial activities
51	3	Administration and services	Public lighting
52	3	Administration and services	Education
53	3	Administration and services	Accommodation

Figure 2. List of activities

IDAppliance	Usage	UsageDetail
1	Office activity / comm	Office activity / comm
2	Other	Other home appliance
3	Other	Other
4	Other	Primary sector
5	Heating	Heating
6	Heating	Electric heating
7	Heating	PAC
8	Domestic hot water	Hot water
9	Domestic hot water	Electric Hot Water
10	Domestic hot water	Hot water
11	Lighting	Lighting
12	Home appliance	Washing machine
13	Home appliance	Dishwasher
14	Home appliance	Small equipment
15	Home appliance	Washing machine
16	Leisure electronics, office, stand-by	Consumer electronics
17	Leisure electronics, office, stand-by	Computing
18	Leisure electronics, office, stand-by	New technologies
19	Leisure electronics, office, stand-by	Information technology
20	Leisure electronics, office, stand-by	TV
21	Motor force	Motor force
22	Cold	Combines
23	Cold	Congel
24	Cold	Cold
25	Cold	Refrig
26	Industrial processes	Industrial processes
27	Thermal usage, cooking	Cooking
28	Thermal usage, cooking	Traditional ovens
29	Thermal usage, cooking	Hotplates
30	Thermal usage, cooking	Thermal uses
31	Ventilation / air conditioning	Air Conditioning
32	Ventilation / air conditioning	Air conditioner
33	Ventilation / air conditioning	Ventilation
34	Thermal usage, cooking	Microwave ovens + kettles
35	Leisure electronics, office, stand-by	Standby

Figure 3. List of electric appliances

5.3 Samples of XML response

The samples below illustrated the XML response of each function. The sample contains comments describing the returned field written in grey.

GetSolarPVPotentialCommune("unige", "xxxx", 2)

```xml
<?xml version="1.0" encoding="utf-8" ?>
<PV_PotentialCommune
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns="http://sccer.unige.ch/">
    <bsf_id>2</bsf_id>
    <commune_name>Affoltern am Albis</commune_name>
    <Commune_area_m2>10593122</Commune_area_m2>
    <Population_2014>11276</Population_2014>
    <Urban_area_m2>2980000</Urban_area_m2>
    <PV_electricity_potential_kWh_year>19988019
                    </PV_electricity_potential_kWh_year>
    <message>Info: data is OK</message>
    <montlyPotential>
    <PV_PotentialCommuneMonth>
        <month_nb>1</month_nb>
        <pv_potential>276231.0289</pv_potential>
        </PV_PotentialCommuneMonth>
    <PV_PotentialCommuneMonth>
        <month_nb>2</month_nb>
        <pv_potential>575850.8926</pv_potential>
        </PV_PotentialCommuneMonth>

    ... data repeated for month 3 to 11 ...

    <PV_PotentialCommuneMonth>
          <month_nb>12</month_nb>
          <pv_potential>196403.8417</pv_potential>
    </PV_PotentialCommuneMonth>
    </montlyPotential>
</PV_PotentialCommune>
```

Federal identifier of commune
Name of commune
Commune surface in m2
Number of residents 2014
Surface classified as urban (CORINE)
potential in [kWh /year]

Message about request processing

Month number 1 = January
potential in [kWh /month]#

Month number 2 = February
potential in [kWh / month]

This data is repeated for each month

Month number 12 = December
potential in [kWh / month]]#

GetSolarPVPotentialPixel("unige", "xxxx", 590000, 143400)

Data to be released in the next version

GetHeatDemandCommune("unige", "xxxx", 2)

```xml
<?xml version="1.0" encoding="utf-8" ?>
<HeatDemandCommune xmlns:xsi="http://www.w3.org/2001/XMLSchema-
        instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
        xmlns="http://sccer.unige.ch/">
    <bsf_id>2</bsf_id>
    <name_commune>Affoltern am Albis</name_commune>
    <NbBuildings>2044</NbBuildings>
    <NbAppart>5438</NbAppart>
    <TotAppSurf>490380</TotAppSurf>
    <Tot_SRE_Est>668758.65592831734</Tot_SRE_Est>
    <Tot_Qh_cc_Est>211039190.47556129</Tot_Qh_cc_Est>

    <Tot_Ehww_Est>304394563.54989129</Tot_Ehww_Est>

    <Perc_Tot_SRE_Est_Res>0.95452363862207135</Perc_Tot_SRE_Est_Res>

    <Perc_Tot_Ehww_EstRes>0.93736261966995738</Perc_Tot_Ehww_EstRes>

    <totalAera>1060</totalAera>
```

Federal identifier of commune
Name of commune
Total number of buildings
Total number of dwellings
Total dwellings surface [m^2]
Total heated surface estimation [m^2] (SRE)#
Useful heat demand for space heating [MJ/year]
Final energy demand for space heating and DHW production [MJ/year] (Ehww)
Percentage of SRE used for residential purpose
Percentage of Ehww demand for residential purpose
Surface of commune in hectares

```
    <totalUrbanAera>0</totalUrbanAera>                  # Surface occupied by urban area #
    <nbPermanentResid>11363</nbPermanentResid>          # Number of permanent residents #
    <message>Info: data is OK</message>                 # Message about request processing #
</HeatDemandCommune>
```

Figure 4. GetHeatDemandCommune() response sample

GetHeatDemandPixel (“unige”, “xxxx”, 590000, 143400, 200)

```
<?xml version="1.0" encoding="utf-8" ?>
  <HeatDemandPixel xmlns:xsi="http://www.w3.org/2001/XMLSchema-
        instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
        xmlns="http://sccer.unige.ch/">
    <P_XMin>590000</P_XMin>                                   # X coordinates of selected pixel #
    <P_YMin>143400</P_YMin>                                   # Y coordinates of selected pixel #
    <pixelSize>200</pixelSize>                                # Size of selected pixel [m] #
    <PCover>1</PCover>                                        # Percentage of buildings with complete at-
                                                                  tributes #

    <NbBuildings>21</NbBuildings>                             # Total number of buildings #
    <NbAppart>28</NbAppart>                                   # Total number of dwellings #
    <TotAppSurf>3543</TotAppSurf>                             # Total dwellings surface [m2] #
    <Tot_SRE_Est>2945.855384352787</Tot_SRE_Est>              # Total heated surface estimation [m2] (SRE) #
    <Tot_Qh_cc_Est>1549789.9793789848</Tot_Qh_cc_Est>         # Useful heat demand for space heating
                                                                  [MJ/year] #
    <Tot_Ehww_Est>1963422.78512309</Tot_Ehww_Est>             # Final energy demand for space heating and
                                                                  DHW production [MJ/year] (Ehww) #
    <TotSRE_1P>1401.04289106371</TotSRE_1P>                   # SRE: Lower bound of 99% conf. interval #
    <TotSRE_5P>1610.90449249569</TotSRE_5P>                   # SRE: Lower bound of 95% conf. interval #
    <TotSRE_10P>1772.7547220525</TotSRE_10P>                  # SRE: Lower bound of 90% conf. interval #
    <TotSRE_90P>4729.17638627712</TotSRE_90P>                 # SRE: Upper bound of 90% conf. interval #
    <TotSRE_95P>5159.04189117701</TotSRE_95P>                 # SRE: Upper bound of 95% conf. interval #
    <TotSRE_99P>6302.52523647737</TotSRE_99P>                 # SRE: Upper bound of 99% conf. interval #
    <Ehww_1P>601138.760197459</Ehww_1P>                       # Ehww: Lower bound of 99% conf. interval #
    <Ehww_5P>848476.530760783</Ehww_5P>                       # Ehww: Lower bound of 95% conf. interval #
    <Ehww_10P>986042.13455061</Ehww_10P>                      # Ehww: Lower bound of 90% conf. interval #
    <Ehww_90P>3389082.57490256</Ehww_90P>                     # Ehww: Upper bound of 90% conf. interval #
    <Ehww_95P>3725550.55099531</Ehww_95P>                     # Ehww: Upper bound of 95% conf. interval #
    <Ehww_99P>4330473.8322281</Ehww_99P>                      # Ehww: Upper bound of 99% conf. interval #
    <Perc_Tot_SRE_Est_Res>1.0000</Perc_Tot_SRE_Est_Res>       # Percentage of SRE used for residential pur-
                                                                  pose #
    <Perc_Tot_Ehww_EstRes>1.0000</Perc_Tot_Ehww_EstRes>       # Percentage of Ehww demand for residential
                                                                  purpose #
    <message>Info: data is OK</message>                       # Message about request processing #
  </HeatDemandPixel>
```

Figure 5. GetHeatDemandPixel() response sample

GetYearlyElectricityDemandCommune **(“unige”, “xxxx”, 323, ByAppliance)**


```xml
<?xml version="1.0" encoding="utf-8" ?>
<YearlyElectricityDemandCommune
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns="http://sccer.unige.ch/">
  <bsf_id>323</bsf_id>
  <commune_name>Bannwil</commune_name>
  <TotalConsumption_MHh>4427.9848615393776</TotalConsumption_MHh>
  <simulationYear>2008</simulationYear>
  <message>Info: data is OK. Data provided by the University of Geneva. DataBase version 1.2 RC 2016/12</message>
<ListDemandByApplianceActivity>
    <YearlyElectricityDemandCommuneApplianceActivity>
        <usageDesc>Air conditioner</usageDesc>
        <ActivityDesc />
        <yearlConsum_MWh>28.898933543570003</yearlConsum_MWh>
        </YearlyElectricityDemandCommuneApplianceActivity>
    <YearlyElectricityDemandCommuneApplianceActivity>
        <usageDesc>Cold</usageDesc>
        <ActivityDesc />
        <yearlConsum_MWh>89.73233210958</yearlConsum_MWh>
  </YearlyElectricityDemandCommuneApplianceActivity>
  <YearlyElectricityDemandCommuneApplianceActivity>
        <usageDesc>Computing</usageDesc>
        <ActivityDesc />
        <yearlConsum_MWh>67.3755598740906</yearlConsum_MWh>
</YearlyElectricityDemandCommuneApplianceActivity>
.....
<YearlyElectricityDemandCommuneApplianceActivity>
        <usageDesc>TV</usageDesc>
        <ActivityDesc />
        <yearlConsum_MWh>63.240173963795137</yearlConsum_MWh>
  </YearlyElectricityDemandCommuneApplianceActivity>
 <YearlyElectricityDemandCommuneApplianceActivity>
        <usageDesc>Ventilation</usageDesc>
        <ActivityDesc />
        <yearlConsum_MWh>249.60242823959183</yearlConsum_MWh>
        </YearlyElectricityDemandCommuneApplianceActivity>
 <YearlyElectricityDemandCommuneApplianceActivity>
          <usageDesc>Washing machine</usageDesc>
          <ActivityDesc />
          <yearlConsum_MWh>89.643659234655345</yearlConsum_MWh>
  </YearlyElectricityDemandCommuneApplianceActivity>
  </ListDemandByApplianceActivity>
 </YearlyElectricityDemandCommune>
```


Federal identifier of commune
Name of commune
Total estimated electric consumption of Commune#
Year for estimation

Start of list of appliance / and / or Activities

Type of appliance (if empty aggregated by activity)
Type of activity (if empty aggregated by appliance)
#estimated yearly consumption for this activity / appliance#

Type of appliance (if empty aggregated by activity)
Type of activity (if empty aggregated by appliance)
#estimated yearly consumption for this activity / appliance#

iterate over all possible activities / appliances

Type of appliance (if empty aggregated by activity)
Type of activity (if empty aggregated by appliance)
#estimated yearly consumption for this activity / appliance#

Figure 6. *GetYearlyElectricityDemandCommune*() response sample

GetHeatLoadCurvePixel **("unige", "xxxx", 590000, 143400, 200 , 0)**


```
<?xml version="1.0" encoding="UTF-8"?>
<HeatLoadCurve_Pixel xmlns="http://sccer.unige.ch/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
<P_XMin>590000</P_XMin>
<P_YMin>143400</P_YMin>
<pieSize>1000</pixelSize>
<PCover>1</PCover>
<NbBuildings>34</NbBuildings>
<NbAppart>46</NbAppart>
<TotAppSurf>5920</TotAppSurf>
<Tot_SRE_Est>6548.5597968557813</Tot_SRE_Est>
<Tot_Qh_cc_Est>685944.13221386</Tot_Qh_cc_Est>
<Tot_Qhww_cc_Est>749867.78948011459</Tot_Qhww_cc_Est>

<Tot_Ehww_Est>913859.09420732921</Tot_Ehww_Est>

<message>Info: data is OK. Data provided by the University of Geneva. DataBase
version 1.3 RC 2018/04</message>
<heatLoadCurve>
  <LC_HourlyLoad>
     <date>2015-01-01 00:00:00</date>
    <qhww_kW>109.97572563804992</qhww_kW>
  </LC_HourlyLoad>
  <LC_HourlyLoad>
    <date>2015-01-01 01:00:00</date>
    <qhww_kW>101.64358402889872</qhww_kW>
  </LC_HourlyLoad>
....
  <LC_HourlyLoad>
    <date>2015-12-31 23:00:00</date>
   <qhww_kW>96.719436927595638</qhww_kW>
  </LC_HourlyLoad>
</heatLoadCurve>
</HeatLoadCurve_Pixel>
```


X coordinates of selected pixel
Y coordinates of selected pixel
Size of selected pixel [m]
Percentage of buildings with complete attributes
Total number of buildings
Total number of dwellings
Total dwellings surface [m2]
Total heated surface estimation [m2] (SRE)
Useful heat demand for space heating [kWh/year]
Useful energy demand for space heating and DHW production [kWh/year] (Ehww)
Final energy demand for space heating and DHW production [kWh/year] (Ehww)
Message

estimated load (Useful energy demand for space heating and DHW) first hour of year (kWh)

iterate over all 8760 hours

estimated load (Useful energy demand for space heating and DHW) last hour of year (kWh)

Figure 7. *GetHeatLoadCurvePixel* () response sample