Myrhorod

GES for Natural Gas and Electrical Efficiency with Co-Generation implementation
City of Myrhorod

General City information

Country – Ukraine
Region – Poltava
Founded at 1575
Total Area – 20km²

Heat and Hot Water demand is ensured by 10 Heating Plants

7 Heating Plants in Myrhorod are to be modernized according to energy efficiency program in 2014-2016
# Plan for Myrhorod

## GESA implementation for 7 heating plants

<table>
<thead>
<tr>
<th>#</th>
<th>District heating plant</th>
<th>Connected Load</th>
<th>Planned Electric capacity, MW(e)</th>
<th>DRT, year of implementation</th>
<th>Co-Generation, year of implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Gcal/hour</td>
<td>MW(th)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Starosvits`ka, 17</td>
<td>10,936</td>
<td>12,719</td>
<td>2</td>
<td>2015</td>
</tr>
<tr>
<td>2</td>
<td>Bagachans`ka, 104</td>
<td>4,714</td>
<td>5,482</td>
<td>2</td>
<td>2015</td>
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<tr>
<td>3</td>
<td>Shyshacz`ka, 80</td>
<td>0,694</td>
<td>0,807</td>
<td>1</td>
<td>2016</td>
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<tr>
<td>4</td>
<td>Gogolya, 100</td>
<td>3,472</td>
<td>4,038</td>
<td>1</td>
<td>2014-2015</td>
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<tr>
<td>5</td>
<td>Gogolya, 156</td>
<td>2,8</td>
<td>3,256</td>
<td>2</td>
<td>2015</td>
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<tr>
<td>6</td>
<td>Gogolya, 181</td>
<td>2,398</td>
<td>2,789</td>
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<td>2015-2016</td>
</tr>
<tr>
<td>7</td>
<td>Prorizna, 4</td>
<td>7,95</td>
<td>9,246</td>
<td>2</td>
<td>2014-2015</td>
</tr>
</tbody>
</table>

|   |                        |               |                                 |                             |                                      |
|---|------------------------|----------------|----------------------------------|-----------------------------|                                      |
Main steps of the program:

- Demand Reduction Technologies (DRT)
- Co-Generation (Combined Heat & Power)
- Use of Alternative Fuels

Program is applicable for:
District heating, hotels, hospitals, schools, shopping centers, residential buildings etc.
Step 1 – First meeting with Client (City Council). Presentation of GESA strategy, advantages, essentials. Potential projects definition. List of projects preliminary approval by City Council.

Step 2 – Potential projects definition convenient for Energy Efficiency technologies application. List of projects preliminary approval by City Council.

Step 3 – 1st visit of Heating Plant. Bills collection for summer and winter periods. DHP plans and as-builds collection.

Step 4 – Initial feasibility study of project case for DRT, Boilers change, Co-generation. 2nd DHP visit for study results (Level 1 audit) confirmation.

Step 5 – NDA and Cooperation Memorandum signature. Obtain from Client all available documentation on agreement to survey list.

Step 6 – Complete audit of all documentation. Upon completion of Level 2 audit, complete 3rd DHP visit to make final verification for Level 2 audit.

Step 7 – Preparation of Green Energy Sustainable Agreement “GESA” Master Service Contract.
Step 8 – Monitoring removable system installation on DHP. Data collection about electricity, natural gas and water consumption during 30 days period.

Step 9 - Procure all final bids on required energy conservation and production initiatives. Complete by the end of the thirty (30) monitoring period.

Step 10 - The installation initiatives to be verified and clarified with each contractor. These contractor bids to be assembled into “GESA” Master Service Contract project exhibits. Complete appropriate “GESA” financial model and submit for project vertical type approval. Upon receipt of parameter approval obtain preliminary finance package approval.

Step 11 – Complete appropriate “GESA” financial model and submit for project vertical type approval. Upon receipt of parameter approval obtain preliminary finance package approval.

Step 12 - Present final “GESA” Master Service Contract exhibits to client for approval. Upon receiving signed approval of exhibits, begin project. Submit and receive final written approval for financial funding.
Heating Plant #7 in Myrhorod

#7, 4 Prorizna str.

Installed capacity 19,5 Gcal/hour
Connected Load 7,95 Gcal/hour
- Heating 5,874 Gcal/hour
- Hot Water 2,076 Gcal/hour
Base temperatures 95-70 °C

Preliminary estimation:
58% of demanded Natural Gas amount can be substituted by syn-gas produced from biomass

КВГ-6,5 3 units  Efficiency 91%

Network Pumps 3 x 90kW (120 hp)
### Myrgorod Project Financials

**Financial Structure**
- GESS/Investor: 30%
- BANK/Finance: 70%

**Project Costs**

<table>
<thead>
<tr>
<th>D.H.P.</th>
<th>Total Cost</th>
<th>City, 7%</th>
<th>City, 10%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>$5,494,939</td>
<td>$2,354,974</td>
<td></td>
<td>$7,849,913</td>
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<tr>
<td>#2</td>
<td>$5,158,580</td>
<td>$2,210,820</td>
<td></td>
<td>$7,369,400</td>
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<tr>
<td>#5,#6</td>
<td>$5,171,369</td>
<td>$2,216,301</td>
<td></td>
<td>$7,387,670</td>
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<tr>
<td>#7</td>
<td>$5,322,689</td>
<td>$2,281,152</td>
<td></td>
<td>$7,603,841</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$21,147,577</strong></td>
<td><strong>$9,063,247</strong></td>
<td></td>
<td><strong>$30,210,824</strong></td>
</tr>
</tbody>
</table>

**Project Results**

<table>
<thead>
<tr>
<th>D.H.P.</th>
<th>Total Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>$11,317,403</td>
</tr>
<tr>
<td>#2</td>
<td>$11,845,914</td>
</tr>
<tr>
<td>#5,#6</td>
<td>$12,596,927</td>
</tr>
<tr>
<td>#7</td>
<td>$11,874,465</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$47,634,709</strong></td>
</tr>
</tbody>
</table>

**City Profit**

<table>
<thead>
<tr>
<th>D.H.P.</th>
<th>Total Revenue</th>
<th>Total Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>$3,455,602</td>
<td>$4,936,574</td>
</tr>
<tr>
<td>#2</td>
<td>$3,053,166</td>
<td>$4,361,666</td>
</tr>
<tr>
<td>#5,#6</td>
<td>$3,170,748</td>
<td>$4,529,639</td>
</tr>
<tr>
<td>#7</td>
<td>$3,368,052</td>
<td>$4,811,503</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$13,047,568</strong></td>
<td><strong>$18,639,382</strong></td>
</tr>
</tbody>
</table>
Step 13 - Hold construction and project site meeting at which time construction schedule and any special project conditions should be clarified.

Step 14 - Verification that all baseline data on the DHP has been correctly documented.

Step 15 – Begin all required architectural and engineering plans required. Begin ordering any and all long lead items after receiving submittal approval.

Step 16 – DRT system design application development for DHP.

Step 17 – DRT system installation and commissioning.
GESA Project Performance
Implementation Phase

Step 18 (optional) – More efficient boilers to be installed on DHP.

Step 19 – Needed construction works design to be developed for Co-Generation turbines and Gazification system (to be done in parallel with DRT system implementation). All permits to be received from all required authorities.

Step 20 – Construction works related to Co-Generation turbines and Gazification system installation to be executed before equipment arrival on DHP.

Step 21 – Co-Generation turbines and Gazification system installation and commissioning.
Control of Energy Demand for a required time period, impacting on temperature and pressure of both air and water capacity providing:

✓ Measurable reduction of natural gas and energy use

✓ Quick and easy to implement

✓ Fast return on investment

✓ Increased Operational Control of Facility
Demand Reduction in Hot Water Supply

Real consumption of hot water during working day

Current operational mode of District Heat Plant

m³/hr

0 500 1000 1500 2000 2500 3000

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

hours

sleep  awake  leave  return
Demand Reduction in District Heating

Reduction of pressure and temperature for given period of time by slowing down the water flow in the system.
Results of Application of DRT in Residential Apartment building

2010 – Adjustment to Demand Operation central pumps; 2011 – Adjustments to central HVAC system; 2012 – Addition of Demand Control Variable Frequency Drives

RESULTS:

- Reduction of natural gas consumption by 30%... 60%;
- Reduction of electric power consumption by at least 50%;
- Reduction of mechanical stress for the piping system.
- Reduction of heating losses in uninsulated pipes

Reduction of pressure and temperature for given period of time by slowing down the water flow in the system
Capstone technology

GESS Consulting Ukraine is the Exclusive Authorized Dealer of CAPSTONE Micro-turbines in Ukraine

PROVIDING:
1. Highly efficient operation on standard natural gas. The common efficiency of the unit in mode of producing both electricity and heat is up to 90%.
2. Ability to increase profit from biomass where the cost of biomass 75% less. The turbines can operate on syngas obtained from biomass for improved profit.
3. Fuel flexibility for minimized Project risk. The turbines allow substitution of syngas or natural gas (from gas supply network) anytime, for both operational and financial risk mitigation.
# Co-Generation is the best choice

<table>
<thead>
<tr>
<th></th>
<th>Straight Boilers Plant vs Co-Generation Plant:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Project Cost</strong></td>
<td>$2,416,000 vs $7,850,000</td>
</tr>
<tr>
<td><strong>Heat Capacity + Hot Water</strong></td>
<td>25 MW vs 25 MW</td>
</tr>
<tr>
<td><strong>Heat &amp; Hot Water Revenue Per Year</strong></td>
<td>$905,000 vs $905,000</td>
</tr>
<tr>
<td><strong>Electric Capacity</strong></td>
<td>0 MW vs 2 MW</td>
</tr>
<tr>
<td><strong>Electricity Revenue Per Year</strong></td>
<td>$0 vs $2,617,000</td>
</tr>
<tr>
<td><strong>Total Yearly Revenue</strong></td>
<td>$905,000 vs $3,522,000</td>
</tr>
<tr>
<td><strong>Yearly Expenses</strong></td>
<td>$689,000 vs $1,715,000</td>
</tr>
<tr>
<td><strong>ROI</strong></td>
<td>11.2 years vs 4.34 years</td>
</tr>
<tr>
<td><strong>Profit for 15 Years Period</strong></td>
<td>$1,266,000 (Including Finance Payments) vs $11,951,000</td>
</tr>
</tbody>
</table>
GESA Project Performance

Execution Phase

Step 22 – Establishing of SPV (GESS and City Council).

Step 23 – SPV is getting all licenses and permissions for electrical and heat power production and supply.

Step 24 – Electrical and Heat energy supply, payment collection and distribution are started for 15 years period.

Step 25 – After 15 years GESS sells its share to City. Project Closure.
“DRT” components to be implemented in Myrhorod

- Monitoring of existing heating plants and heating supply systems parameters (gas and electricity demands, heat losses etc.)
- Variable Frequency Drives (VFD) installation
- Boiler controls installation
- Solenoid valves installation
- Sleep-Awake-Leave-Return automation implementation
Automation of a Heat Plant using Variable Frequency Drives (VFDs)
District Heat Plant #1
Electric capacity - 2 MWe
Connected load - 12.72 MW(th).
Plan A:
With biogas supply by the pipeline from outside the city
District Heat Plant #2
Electric capacity - 2 MWe
Connected load - 5.48 MW(th).
Plan B:
With biogas supply by tank cars from outside the city

Capstone C1000:
- Weight, kg: 18144
- Dimensions LxWxH, mm: 9144 x 2438 x 2896
- Voltage: 380...400 V
- Maximum phase output current, A: 1550

Transformer
- Schneider Electric
- TRIHAL 0.4/10 kV
- 3150 kVA

Switchboard
- Schneider Electric
- OKKEN 0.4 kV 5000 A

Heating network
- Heat Exchangers UT 65

I liquefied biogas storage tanks
District HP #7
Use of biomass gasification system at the site
Green Zone creation projects

DISTRICT HEATING PLANT:
- CAPSTONE MICRO-TURBINES
- BOILERS [for extra heat load]
- BIOMASS GASIFICATION SYSTEM

RELATED TERRITORY [playground, sidewalks, roads etc.]

SOLAR POWERED STREET LIGHTS

Pipes replacement

GRID

POWER SUBSTATION

IFI

HEATING NETWORK

COMMERCIAL BUILDINGS

CONSUMERS:
- RESIDENTIAL BUILDINGS
- BUDGETARY BUILDINGS
- COMMERCIAL BUILDINGS
- ENERGY EFFICIENCY OF BUILDINGS

HOT WATER SUPPLY NETWORK

SEWER NETWORK

GESS Consulting Ukraine

European Investment Bank or IFI

GESS Consulting Ukraine

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Benefits for City of Myrhorod

- City budget savings can be used for infrastructure reconstruction and development (pipelines, city lighting, roads, electrical networks, parks, schools, kindergardens, hospitals etc.)

- Independent and cheap sources of energy to be used (wood chips/pellets, biomass etc.)

- More reliable, highly efficient, modern facilities are installed

- Reduction of CO₂ carbon emission

- New jobs & tax incomes
HOSPITAL GREEN ZONE EXAMPLE

- THERMAL SOLAR SYSTEM
- ROOF
- AIR CONDITIONING SYSTEM (HVAC)
- NEW PLUMBING SYSTEM
- WALLS
- LIGHTING
- FLOORING
- CAPSTONE MICRO-TURBINES: CO-GENERATION HEAT PLANT
- HOT WATER SUPPLY
- HEATING
- COOLING
- ELECTRICITY
Area around completed District Heating Plants

City of Myrhorod

GREEN ZONES
Myrhorod City Council and GESS Consulting Ukraine agreed to implement the following:

1. Public Awareness

2. Demand reduction technologies

Public Awareness Campaign must promote the acceptance of Demand Reduction Technologies (DRT). It’s THE ONLY COMBINED solution to achieve mandatory 30% reduction of natural gas energy consumption in time.

3. Implementation of Co-Generation technologies

4. Substitution of natural gas by alternative fuels
Public Awareness Campaigns on “DRT”

1. Active popularization of the advantages of Energy Efficiency measures for citizens, businessmen, governmental institutions via mass media, billboards, booklets, theme events, seminars, school lessons etc.

2. Explanatory events and actions about Energy Efficiency measures implementation on end-users levels and on city level.

3. Positive examples about Energy Efficiency measures implementation from users in different countries.
CONTACT US!

For Additional Information and/or Questions

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