

Novi Sad Energy Complex (case study)

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Vojvodina Province and City of Novi Sad



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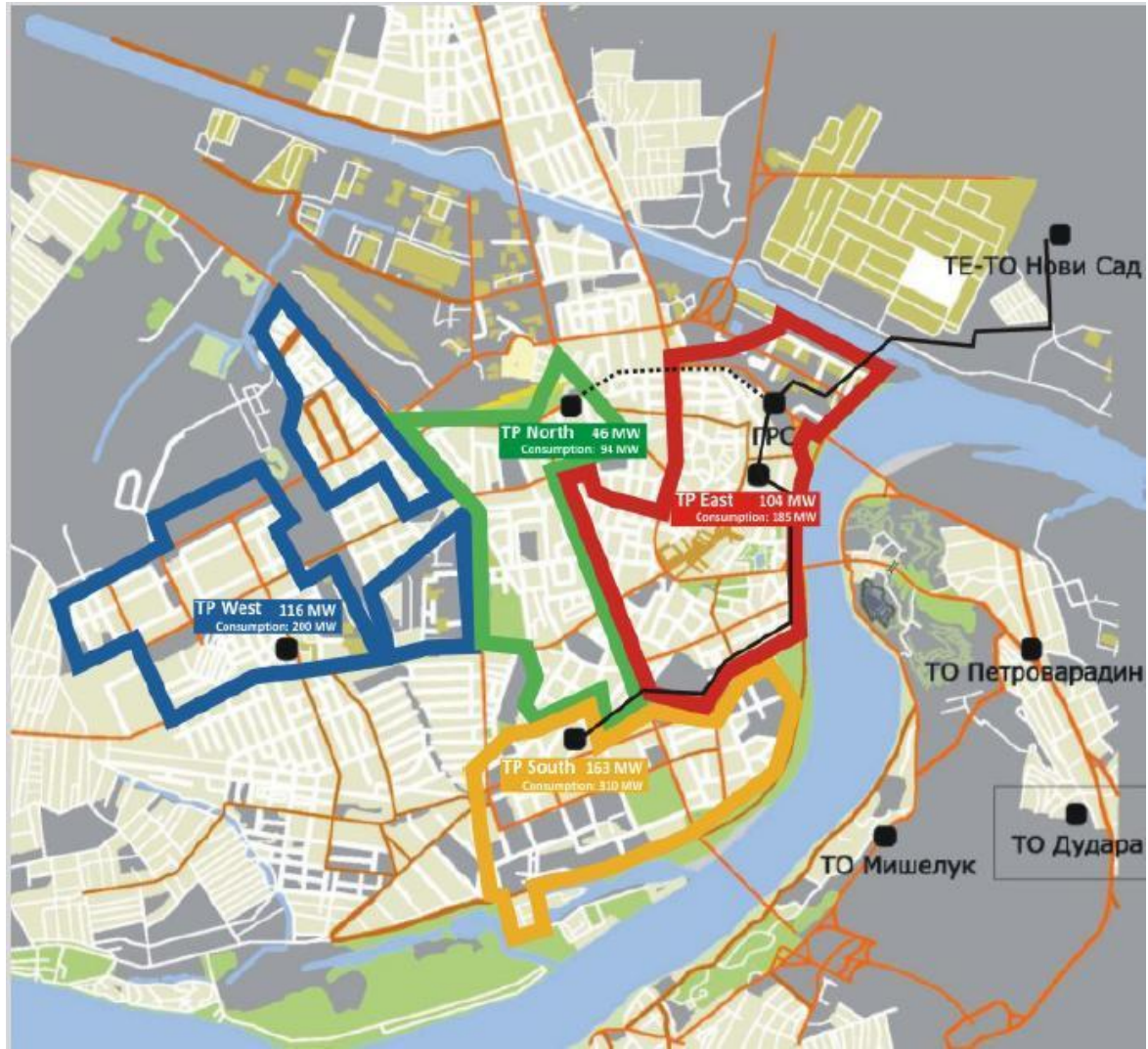
Novi Sad Energy Scene

- City of Novi Sad is supplied by three major energy service companies:
 - District Heating company of Novi Sad
 - Combine Heat (or) Power Plant (CHP) Novi Sad and
 - Natural Gas distribution company “Novi Sad”
- Roughly half of the City is covered by district heating services that are delivered to over 80000 residential customers and almost 7000 commercial customers with total peak heat demand over 840MWt.
- Electricity is provided to entire Vojvodina province by EPS subsidiary ElectroVojvodina. Its total sales in 2008 was over 7800GWh. City of Novi Sad (metropolitan area) accounts for about 30% of electricity markets.

District heating company of Novi Sad

- Government owned company
- Heat is produced in four heat-only-boiler plants with total capacity of almost 640MWt. All plants are fueled by natural gas while some boilers are equipped with dual fuel capacity and able to burn Heavy Fuel Oil.
- Provides space heating services and negligible proportion of domestic hot water services.
- City is divided to four district heating zones.
- Zones East and South are connected to CHP Novi Sad that provides additional heat. Heat-only-Boiler plants in these zones are not sufficient to cover heat demand.

District Heating zones in Novi Sad



CHP Novi Sad



EPS subsidiary

Built from 1981-1985

Three steam boilers:
2x420t/h+1x500t/h

Two steam turbines
135MWe and 110MWe
with steam extraction for
district heating hot water
production

Hot water delivered to
the City by 3.2km hot
water pipeline

Gas and power network
connections

One investment concept for biomass / CHP option

- Replace gas / HFO fired boilers with biomass fired boilers. Three boilers feeding steam to the same steam system to provide 245MWe base load operation up to 7000 hours a year
- In addition to steam extraction from existing turbines, make use of waste heat and replace electricity power circulation with gas powered engines in CHP mode.
- Develop gas / HFO engine based CHP with up to 100 MWe at the site to cover variable load
- Introduce advanced DH system management and heat storage at DH network to increase utilization of assets and decouple power plants from characteristics of the heat load
- Provide efficient district cooling
- Retain connections to gas and electricity grids, HFO reserve fuel system, water cooling system, exhaust gas system and heat delivery system
- Plan sequential development according to least cost and cost benefit analyses.

Site arrangement including **biomass storage**, **new power plant** and ash (fertilizer) disposal



Capacity specifications for biomass / CHP

option

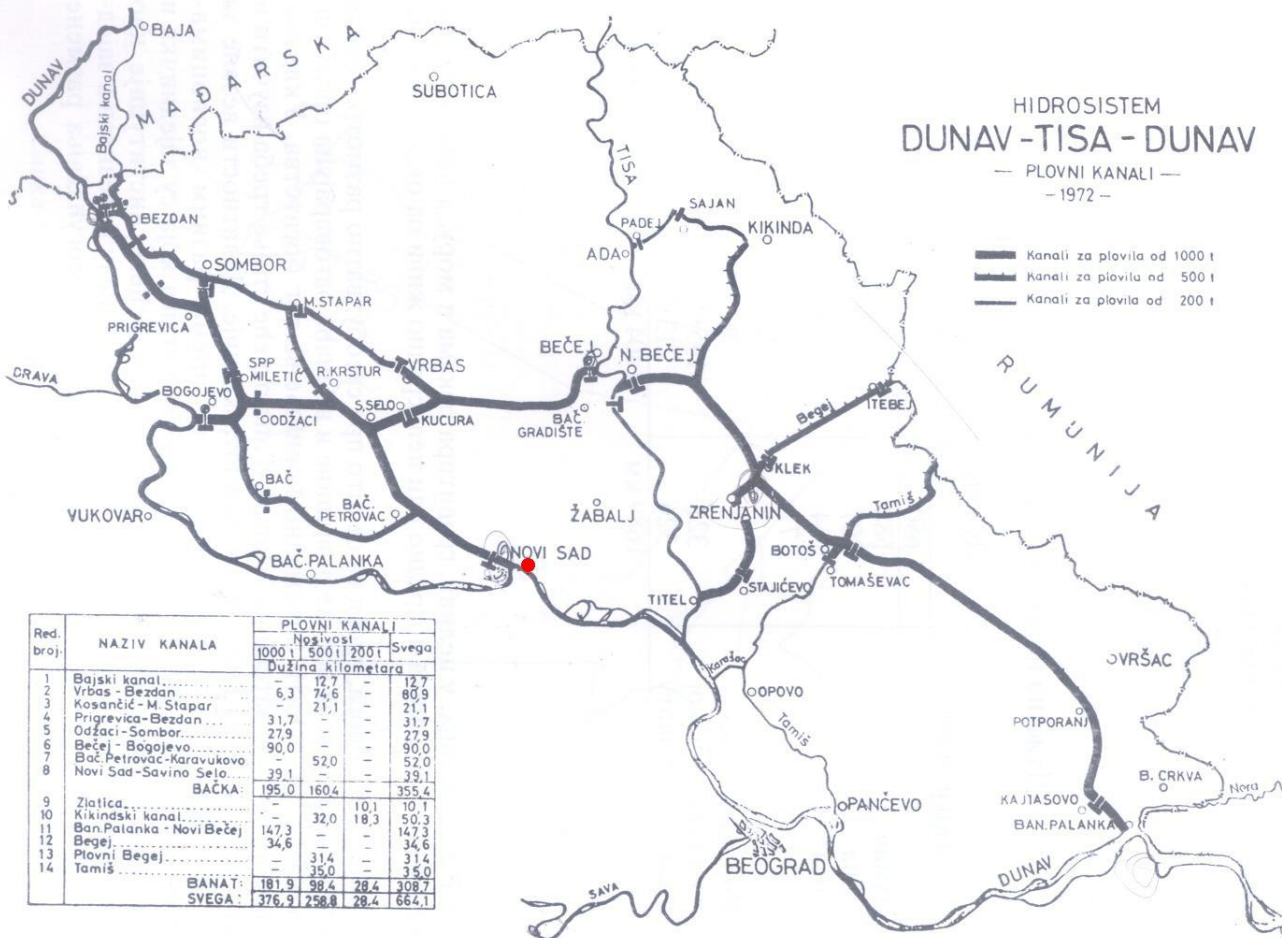
Note: New or additional heat capacity is designed hereby to meet or exceed expectations from the Investment Opportunity Document. If district heating system in Novi Sad is properly optimized much lower heat capacity would be required and therefore lower investments and gas consumption would be needed. Heat used internally for biomass drying is not considered.

Investment tug: about 200million Euros over 4-10 years	Electricity	Heat
Existing plant, boilers converted to biomass	Variable 70 -245MWe CHP or Electricity only	Variable from 0-332MWt
Gas (HFO) engine based plant	Variable 4-100MWe	Variable from 4-110MWt
Waste heat utilization and circulation pumps	Avoids about 30MWe internal electricity consumption	Variable from 30- 255MWt
Total output capacities	Variable from 4-345MWe	Variable 30-697MWt Maximum new: 365MWt

Biomass supply options (1)

- Vojvodina province is a special case in Europe in terms of biomass production and logistics.
- Vojvodina province surface area is 2156000 hectares. About 7% is covered by forests while about 80% of forests are artificial planted poplar forests available for intensive exploitation. By EU accession agreements Vojvodina is obliged to increase forest cover for another 400000+ hectares to about 27% of area.
- Vojvodina is also home of some of the most advanced poplar and agriculture biomass technology and seeding material providers.
- Biomass producing area is covered by rivers and navigable channels with throughput capacity comparable to Panama Canal: about 1689km of navigable canals and rivers create a density of transport capacity comparable to Netherlands while entire area is flat and well supplied by railways and roads.

CHP Novi Sad is located at major cross-road of navigable waterways



Navigation with self propelled vessels and barges up to 1650 DWT possible in these waterways. Existing Serbian fleet for dry cargo includes plenty of vessels and various owners. Maintenance and shipbuilding well facilitated.

Biomass supply options (2)

- Biomass CHP of 245MWe capacity requires about one million tons of biomass for regular operation of 7000 hours per annum. Requirement will be built up gradually over years since boilers could be converted one by one.
- About 80% should be wooden biomass (wood, wood residues and wooden biomass from agriculture) while 20% could be regular agriculture biomass.
- It is to be considered that agriculture biomass is readily available from a number of different providers and a range of longer term contracts could be available at competitive terms.
- Wood biomass could be secured at this moment from only few providers.
- Government of Serbia have changed ruling on land use to allow further categories of agriculture land to be converted into forests that is going to facilitate development of private forests in Vojvodina and eventually facilitate increase of forested area in line with EU accession requirements.

Biomass supply options (3)

- Largest potential providers of biomass in Vojvodina are Vojvodina Forests (with 130589 hectares concentrated in only 7 dedicated areas) and Vojvodina Waters (with 7575 hectares of forests and land available for forestation) that are recently formed government owned entities subordinated to provincial administration in Novi sad. Utilization of these resources is small with comparison of its capacity achieved in 1980's before entire resources were shifted under control of central government in Belgrade.
- National Park (22450 hectares) and resort Karadjordjevo (2243 hectares) operate more natural forests with lower yields while there are 5567 hectares of privately owned forests with potential high productivity upon market demand.
- Forestry institutes forecast that existing forest resources could provide 3.6 million cubic meters of wood biomass per annum or 1.6 million tons.
- Experiments conducted by the Poplar Institute in Novi Sad prove that production rate of biomass with 65MWh of energy content per hectare per annum is realistic assumption providing that up to 80000 hectares of poplar forests will create sufficient fuel base of the CHP in Novi Sad.
- Such volume of poplar forest area is available with Vojvodina Forests.

Some comparisons

	CCGT / CHP option	Biomass / CHP option
Cap-ex	>300 million Euro	<250 million Euro
Price of heat	Higher than current	Lower than current
Fuel	Natural gas	Gas and biomass with HFO in reserve
Production risks	Gas supply, large scale technical failure	No scope for large scale failure
Investment	Large upfront investment and long period until first generation	Gradual build up of capacity and efficiency and incremental increase in capacity
Electricity	Base load facing strong competition	Variable load combined with peaking capacity
Flexibility on fuel cost risk	Limited	Considerable