The impact of Serbian national energy efficiency action plan (NEEAP) on EU2020 goals

Nikola Rajaković, Ilija Batas Bjelić
Department of Power Systems
School of electrical engineering, University of Belgrade
11000 Belgrade, Serbia
rajakovic@etf.rs

***Abstract*— Serbia has good opportunity to improve energy efficiency which has been the least developed goal within 27 EU countries so far. For improvement of energy efficiency on national level the NEEAP measures in Serbia have been proposed in line with EU2020 strategy to achieve savings in gross energy consumption of 9% in the year 2018. Possible contributions of NEEAP on climate and energy goals together with economic outcomes have been modeled and calculated with the EnergyPLAN software. The direct impact of NEEAP is 7% on greenhouse gasses emission reduction with cross-effects of 0.9% increase in the share of renewable energy in Total Primary Energy Supply (TPES) and 6% improvement in energy efficiency.**

Keywords- energy efficiency; national action plan; energy systems modeling

I. INTRODUCTION

Serbian energy intensity of 1.61 toe/1000$$_{2000}$ (calculated as the market exchange ratio) is the second highest in Europe (after Bulgaria) and the third highest of 0.44 toe/1000$$_{2000}$ (after Island and Bosnia and Herzegovina) calculated as purchasing power parities [1]. This low energy intensity it is definitely a good candidate for improvement since of many measures still might be applied. In the scope of the current Serbian Energy Strategy [2], energy efficiency has been recognized as the second, directed priority of the economical use of quality energy products and increase in the energy efficiency in the production, distribution and utilization of energy by the end consumers of energy-related services. Energy efficiency has also been recognized as a priority in the National Sustainable Development Strategy [3]. The European Council adopted in 2007 ambitious energy and climate change goals for 2020 – to reduce greenhouse gas emissions by 20% (even rising to 30% if the conditions are favorable) to increase the share of renewable energy to 20% and to make a 20% improvement in energy efficiency [4]. The overall percentage of primary energy consumption savings for EU27 in 2010 due to energy efficiency measures was 5.44%. This is the least achieved goal and most difficult one for 27 EU countries comparing with the greenhouse gas emission reduction (achieved 15%) and the share of renewable energy (RE) in gross final energy consumption (achieved 12.5%) [5]. EU accession process creates similar goals for Serbian energy policy. With showing successful primary energy consumption savings Serbia may be one good example that this difficult goal could be achieved. Since the energy efficiency target is relatively easier to achieve and since Serbia might become good example this opportunity should not be missed.

With the National Energy Efficiency Action Plan (NEEAP) [6] Republic of Serbia has adopted a national indicative energy savings target of not less than 9% of the final inland energy consumption to be achieved for the period from 2010 to 2018, which means that the country should ensure energy savings amounting to 8.76TWh in the last year of this plan. The reference year 2008 and official Energy Balance 2010 have been used.

In this paper the EnergyPLAN [7] has been used to model national indicative energy savings target and measures within NEEAP scenario. With this tool possible impact of suggested measures on other energy and climate goals (proposed by EU2020 Strategy) have been calculated. In addition economic benefits of NEEAP have been presented.

II. METHOD

The reference energy system has been changed with proposed energy savings. NEEAP saving measures in year 2018 are modeled and calculated within EnergyPLAN. The resulting and the reference energy system are compared. Changes in demand different from those proposed within NEEAP have not been considered.

A. Reference scenario

For Serbian energy system reference scenario year 2009 was used. Electricity demand curve and yearly consumption was obtained from ENTSO-E data [8]. District heating and CHP data was obtained from [9], thermal power unit data was obtained from [10] while fuel data and its distribution from [1, 11] and efficiencies are calculated from data found in [12]. The heat demand and load curve has been calculated in Excel by using degree-day and temperature obtained from METEONORM program [13]. Run-of river hydro, storage hydro and pump storage electric power units production curves are calculated from monthly balances obtained from [8] while capacities are obtained from [10]. The efficiency of energy conversion in individual house heating sector is assumed as shown in Table I.

TABLE I. EFFICIENCY OF ENERGY CONVERSION IN INDIVIDUAL HOUSE HEATING SECTOR

Fuel	*Lignite*	*Oil*	*Natural gas*	*Biomass*	*Electric heating*
η	0.75	0.85	0.9	0.75	1

The yearly amount of energy used for electric heating in individual house heating sector is obtained from [14]. The heat pump efficiency has been taken to be 3.

B. NEEAP scenario (national indicative energy savings target)

The reference scenario has been changed to model savings resulting from proposed set of saving measures in three different sectors for the year 2018. These sectors include: industry, transport and other (residential, commercial and public services) sector. Resulting scenario was called NEEAP scenario. Total energy savings are targeted to be 9% of final inland energy consumption which amounts to 8.76TWh for the year 2018.

Assumed model of saving measures is structured as:

- Heat demand (HD), where savings are shared between:
  - District heating (DH) and,
  - Individual House Heating Demand (IHHD) savings.
- Electricity demand (ED) savings.
- Fuel in Transport (FiT), where savings are shared between:
  - Diesel,
  - Petrol, and
  - Liquefied petroleum gas (LPG) savings.
- Fuel in Industry (FiI) where savings are shared between:
  - Lignite,
  - Oil, and
  - Natural gas savings.

Assumed model of saving measures in detail is explained in next subchapters.

1) Saving measures in industry sector

Foreseen agreements with industry initiated by the Energy Efficiency Agency, Serbian Industrial Energy Efficiency Network (SIEEN), Regional Energy Efficiency Centers (REECs), have been modeled as industrial CHP power plant which can contribute to meet household district heating demand under assumed demand curve.

Introduction of energy management for big industrial consumers with control and regulation improvements resulted in savings in ED and FiI. These savings are distributed equally among lignite, oil and natural gas.

Energy audits measures in industry are resulting both in ED and HD savings.

2) Saving measures in transport sector

Energy efficiency measures proposed with NEEAP in the transport sector include: introduction of European standards for energy efficiency in the transport sector, creation of an energy efficient transport system, promotion of eco-driving and low cost energy efficient measures in transport, introduction of road transport fleet management and introduction of incentive mechanisms for the replacement of existing fleet.

These measures together contribute in total with 2.28TWh in FiT savings. These FiT savings are distributed equally among dominantly used fuels in transport: diesel, petrol and LPG. Amount of natural gas used in transport sector remained unchanged.

3) Saving measures in other sector

Proposed energy savings in residential, commercial and public services sectors with NEEAP are 3.53TWh.

Improvement or replacement of residential building outside doors, windows, thermal insulation resulted with savings in HD.

Replacement of conventional incandescent light bulbs with energy efficient ones and promotion of the use of energy efficient electrical household appliances resulted with savings in ED.

From the electricity for heating purposes (2.991TWh) amount of 0.1TWh has been taken and substituted with heating pumps and this resulted in two thirds of saving in ED while same heat demand is satisfied.

New rules of building design and construction, minimum energy performance standards (energy efficiency) and certificates of building energy performance in accordance with revised EPBD together with billing on the basis of actual (measured) consumption of energy by consumers connected to district heating system contributed with savings in HD.

Introduction of the energy management system in public and commercial buildings resulted in savings both in ED and HD.

Energy Efficiency Project of the Republic of Serbia is accounted with HD savings.

Agreements with municipalities on modernization of public lighting systems are contributing to ED savings.

Total ED is lowered for 2.64TWh, HD for 2.2TWh (DH one third and IHHD two thirds). Fuel demand in transport is lowered for 2.28TWh. Fuel in industry is lowered for 1.42TWh. In the case of district heating total district heating demand was lowered while hourly distribution remained the same. In the case of fuel savings in IHHD sector it was assumed that most CO_2 intensive fuel (lignite) will be excluded in first step to maximize savings.

III. RESULTS

Energy efficiency measures proposed within NEEAP means the savings of 8.76TWh in the final inland energy. On the primary side the resulting amount is 10.31TWh or 6% of savings in TPES. Possible contribution of suggested measures within NEEAP for the year 2018 on various goals in comparison to the reference scenario is shown in Table II.

TABLE II. POSSIBLE CONTRIBUTION OF NEEAP IN YEAR 2018 IN COMPARISON WITH REFERENCE SCENARIO

Goals	Scenario	
	Reference	*NEEAP*
CO_2-emission (total) [$MtCO_2$]	46.838	43.568
RE share of TPES [%]	13.5	14.4
RE share of elec. prod. [%]	28.1	30.2
RE electricity production [TWh/year]	10.47	10.47
Fuel Consumption (total) [TWh/year]	169.37	159.06
Annual costs (total) [M€]	6999	6572

Contribution of NEEAP to the first energy and climate goal of EU2020 Strategy (the reduction of CO_2 emission) has been calculated as 3.27$MtCO_2$/a of savings, or 7% of reduction. Avoided emissions are 2.28$MtCO_2$ from coal, 0.65$MtCO_2$ from oil and derivatives, and 0.34$MtCO_2$ from natural gas. Although RE production remains unchanged (10.47TWh), share of RE in TPES and in electricity production is higher for 0.9% and 2.1% respectively, because TPES and electricity production are lowered. Total annual costs are lowered for 427M€ mainly due to fuel costs and slightly due to CO_2 costs (10€/tCO_2).

IV. CONCLUSION

Direct impact of Serbian NEEAP on the third EU2020 goal (primary energy consumption savings as the targeted goal) has been computed by using the EnergyPLAN tool.

Additionally, the positive impact of NEAAP on other goals has been achieved as the cross-effect. The increase of share of renewable energy sources in gross energy consumption as the first goal, and reduction of greenhouse gas emissions as the second EU2020 goal also has been achieved. Finally, total annual costs are reduced which opens economic potential for energy savings measures.

In future in Serbian energy policy documents all EU2020 goals should be considered in the synergy context and with cross-effects in order to optimize investments.

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