



Vision 2023: Scrutinizing achievability of Turkey's electricity capacity targets and generating scenario based nationwide electricity demand forecasts

Mehmet Melikoglu

Department of Chemical Engineering, Gebze Technical University (GTU), 41400, Gebze, Kocaeli, Turkey



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ABSTRACT

In the last couple of years, Turkey faced serious economic and geopolitical problems. As a result, many from the academia and industry now have suspicions about the viability of Turkey's Vision 2023 electricity targets. Consequently, in this study an up to date forecast of Turkey's electricity demand till 2023 is generated and achievability of the Vision 2023 electricity capacity targets are scrutinized. Turkey's electricity demand till 2023 is forecasted using the semi-empirical electricity demand model generated in this study. Different average % annual electricity demand per capita growth scenarios are used for the electricity demand modelling. Results from the modelling study showed that Turkey's electricity demand in 2023 could be 327,000 GWh if the very low demand scenario occurs or 362,000 GWh if the low demand growth scenario prevails or 386,000 GWh if the medium demand growth scenario succeeds or 429,000 GWh if the high demand growth scenario happens. The demand forecasts generated in this study match 94.3% (or higher) with previous forecasts found from the literature. The scrutiny showed that wind energy installed capacity in 2023 (estimated at nearly 11,000 MW) might be significantly lower than the official target of 20,000 MW. It is also pinpointed that one nuclear power plant might become operational (25% operational – one out of four units/reactors) instead of the planned two in 2023. Putting these potential target deviations aside, the scrutiny showed that Turkey's installed capacity in 2023 would most probably be greater than 110,000 MW and might in fact reach to the planned 120,000 MW. This is an important finding for policy analysts and researchers. Finally, it is suggested that the work on Turkey's energy projects must be accelerated and some of the Vision 2023 installed capacity targets (wind and nuclear) should be revised by the authorities.

1. Introduction

In 2000, Turkey's electricity demand was nearly 128,000 GWh [1]. Turkey's electricity demand more than doubled ($\times 2$) and it reached nearly 279,000 GWh in 2016 [1]. Turkey's total installed capacity also grew in the meantime in order to generate the electricity required to supply this demand. In 2000, Turkey's total installed capacity was nearly 27,250 MW [2]. Turkey's total installed capacity almost tripled ($\times 3$) and it reached nearly 78,500 MW in 2016 [2,3]. It is expected that Turkey's electricity demand will continue to increase in the following years [4]. Consequently, Turkey's total installed capacity must grow in the meantime in order to generate the electricity that will be required to supply Turkey's increasing electricity demand.

According to Turkey's Vision 2023 energy targets Turkey's total installed capacity is expected to reach 120,000 MW in 2023 [5]. The year 2023 is the first centennial of the Republic's foundation and it is

particularly important for the Turkish people. The Turkish government announced a set of targets for 2023 under the Vision 2023 agenda in early 2010s [6–8]. Energy is one of the most important topics of the Vision 2023 agenda [4]. Previous and current versions (February 2017) of Turkey's Vision 2023 energy targets are given in Table 1 [9–11].

As can be seen from Table 1, Vision 2023 energy agenda sets very ambitious installed capacity targets (total, coal, renewable and nuclear) for Turkey. Almost 7 years past (2010–2017) since the announcement of these targets and Turkey has only 6 years (2017–2023) left to realize them. As a result, many from the academia and industry ask themselves “Are these installed capacity targets (total, coal, renewable and nuclear) achievable or not?” Consequently, the first aim of this paper is to analyse achievability of Turkey's Vision 2023 electricity capacity targets. Secondly, installed capacity is increased in order to generate the electricity that is or will be required to supply current or future electricity demand. Otherwise, excess capacity build-up will be a waste of

E-mail address: mmelikoglu@gtu.edu.tr.

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Table 1
Turkey's Vision 2023 targets for the energy sector in 2017 [9–11].

Topics	Previous Targets [9,10]	Revised Targets as of February 2017 [11]
Fossil fuels		
Coal	30,000 MW	Unchanged
Natural gas storage capacity	5 billion m ³	Unchanged
Renewable energy sources		
Biomass based power plants installed capacity	2000 MW	Unchanged
Geothermal power plants installed capacity	600 MW	Increased to 1000 MW
Hydroelectric power plants installed capacity	Maximum or 36,000 MW	Unchanged
Solar power plants installed capacity	3000 MW	Increased to 5000 MW
Wind power plants installed capacity	20,000 MW	Unchanged
Share of renewable sources in energy production	30%	Unchanged
Energy transmission and distribution		
Length of transmission lines	60,717 km	Unchanged
Power distribution unit capacity	Reaching to 158,460 MVA	Unchanged
Utilisation and extension of smart grids	Established	Unchanged
Energy Market		
Establishment and operation of an energy stock exchange	Established	Unchanged
Nuclear Energy		
Nuclear power plants	2 operational (3rd under construction)	Unchanged
Total installed power capacity	120,000 MW	Unchanged

resources. Yet, an estimate for Turkey's electricity demand is not published in the official Vision 2023 energy targets [9–11]. The author previously generated a demand forecast for Turkey till 2023 [4]. However, this demand forecast was a preliminary study [4]. Therefore, the second aim of this paper is to generate an up to date forecast of Turkey's electricity demand till 2023. This paper is structured as follows: In the next section, achievability of Turkey's Vision 2023 electricity capacity targets will be scrutinized. Then, after an up to date review of the literature, a model will be generated to forecast Turkey's electricity demand till 2023 in Section 3. Finally, conclusions drawn from this study will be given in Section 4.

2. Achievability analysis of Turkey's vision 2023 electricity capacity targets

Detailed analysis of Turkey's Vision 2023 energy targets can be found in references: [4,5,12–19]. Installed capacity of power plants based on energy source in Turkey at the end of 2016 and potential % share of these power plants in 2023 (if Vision 2023 energy targets are realized) is given in Table 2 [9–11,20]. Also, installed capacity build-up based on different energy sources between 2010 and 2016 are given in Fig. 1 [3]. This figure shows the progress on individual installed capacity targets since Vision 2023 energy targets were announced. In

addition, linear extrapolations (using Microsoft Excel 2007) till 2023 were carried on these different installed capacities as shown in Fig. 1. It is known that these extrapolations do not indicate or guarantee any installed capacity build-up. However, these extrapolations can simply provide an opinion if individual installed capacity targets of 2023 can be realized or not (assuming capacity build-up trend between 2010 and 2016 continues till 2023). In this study, the progress on realization and achievability of individual Vision 2023 electricity capacity targets will be assessed using Fig. 1, Tables 1 and 2

Hydropower is Turkey's primary renewable energy source (see Table 2). As a result, Vision 2023 hydroelectric installed capacity target is set to 36,000 MW (see Table 1). If all Vision 2023 energy targets are realized then hydropower will provide 30% of Turkey's total installed capacity in 2023 (see Table 2). As can be seen from Table 2, Turkey's total hydropower installed capacity (hydro dam type and hydro river type) reached nearly 26,700 MW (or 34% of current total installed capacity) at the end of 2016. This means that nearly 74% of Turkey's Vision 2023 hydropower target has been realized so far. Consequently, if planned hydropower plants will become operational on time then Turkey's Vision 2023 hydropower target might be realized by 2023. Also, Fig. 1 shows that if the capacity build-up trend between 2010 and 2016 continues till 2023 then it is possible that Turkey could fulfil its Vision 2023 hydroelectric total installed capacity target. However,

Table 2
Installed capacity of power plants based on energy source in Turkey at the end of 2016 and their potential % share of total installed capacity in 2023 if Vision 2023 energy targets are realized [9–11,20].

Fuel type [20]	Installed capacity at the end of 2016, MW [20]	Share of total installed capacity at the end of 2016, % [20]	Share of total installed capacity in 2023, % (if Vision 2023 energy targets are realized) [9–11]
Fuel oil + naphta + diesel	369	0.5	N/A
Geothermal	821	1.1	0.8 (geothermal)
Hydro dam type	19,559	24.9	30.0 (hydropower)
Hydro river type	7123	9.1	
Imported coal	7474	9.5	25.0 (coal)
Indigenous/Domestic (Bituminous coal + lignite + asphaltite)	9842	12.5	
Multiple fuels liquid + Natural gas	3354	4.3	N/A
Multiple fuels solid + Liquid	667	0.9	N/A
Natural gas + LNG	22,156	28.2	N/A
Renew. + Waste + Semi-Waste Pyrolysis oil	467	0.6	1.7 (biomass)
Solar	13	0.0	4.2 (solar)
Solar (Unlicensed)	820	1.0	
Thermal (Unlicensed)	82	0.1	
Wind	5738	7.3	16.7 (wind)
Wind (Unlicensed)	13	0.0	
Total	78,497	100.0	100.0

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