The IICEC-Sabancı University TIMES Energy Model (ISTEM) is a technology-rich bottom-up optimization model under development by IICEC and Sabancı University which represents energy dynamics over a multi-period time horizon in the context of Turkish energy system.

Similar to other bottom-up models, ISTEM requires comprehensive information about each and every aspect of energy systems: Supply (production, import, export, etc.), Conversion/Transmission, and Consumption (demand in residential, industry, etc.). The more detailed information we provide, the more precise results we acquire. However, ISTEM is a very distinctive optimization model, compared to almost any other energy technology optimization model, in that the reference energy system is being defined, for the power sector, not as classes of energy generating technologies, but as separate power generating plants. This provides several advantages at the expense of a more extensive data collection process. A model characterized at this level will more accurately represent and predict the characteristics and performance of the Turkish power sector as a whole. In addition, this level of detail can accommodate knowledge about planned additions to Turkish electricity capacity (tenders, contracts, etc.) and provide a more reliable prediction of what the Turkish reference energy system will look like in future periods, since the optimization conducted for those periods will already accommodate what is expected about future power additions instead of just trying to estimate them.

To provide enough input for the proposed data-rich model, we rely on a wide variety of databases, such as ETSAP-Technology data, IEA reports, TURKSTAT documentations, Turkish State Meteorological Service, and information about business developments in the Turkish power sector that are not yet reflected in statistical databases. ISTEM is in data collection and development phase to generate “reference energy system”.

Contrary to short-term analysis in which economic methods may provide useful projections, using scenarios is the only practical choice to analyze the future projections given the long horizons. A scenario is a set of coherent assumptions that describes the main drivers’ trajectories, which leads to a coherent organization of the system under study. In sum, scenarios will generally focus on different factors that affect the power sector:

- Primary resource supply
- Energy service demand
- Technologies
- Policies

Solving different scenarios may lead to contrasting solutions; therefore, comparing these unequal solutions can reveal important information about the role of dissimilar components in the energy system. ISTEM can be used to explore the possible energy futures assuming various contrasting scenarios. Differences among scenarios can concern:
• differing government policies (this can cover a wide variety of factors that would affect the selection of power generating technologies – these could involve stricter environmental standards, different tax regimes designed to promote energy security and many others);
• different assumptions about future improvements in the cost or performance of power generating technologies;
• different assumptions about the emergence of new power generating technologies or other technologies (such as energy storage) that affect the economic performance of power generating technologies;
• different assumptions about natural conditions (such as rainfall trends) that would affect the performance of certain power generating technologies;
• different estimates of future Turkish economic growth;
• different estimates of future interest rates; and others.

Therefore, our TIMES model, ISTEM, is expected to provide the following major research opportunities:

1. Predicting the long-term development of the dispatched power from each technology and power plant.
2. Observing the impact of regulations\(^1\), technologies\(^2\), and market players’ configuration on each energy carrier, technology, and demand.
3. Environmental effects of current technologies on the viability of each technology in the Turkish energy system.
4. Investigating socio-economic factors on interchangeable technologies and the energy demand from each source.
5. Assessing the economic viability of investments in lesser-known future technologies and their success in the context of Turkish energy system.
6. Estimating the most cost effective combination of technologies that meet specified greenhouse gas (GHG) emission objectives.
7. Estimating key research priorities to value the cost of clean energy development.
8. Assessing the possibility of using new technologies\(^3\) as frequency regulators and fast-response reserves for integrating intermittent generation sources such as renewables.

This model provides managerial insights to policymakers. Moreover, results can be used as fodder by top-level executives or managers of smaller businesses and customers to maximize their welfare.

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\(^1\) introducing new regulations or changing current ones
\(^2\) such as breakthroughs in existing technologies or adding new technologies that were not previously available
\(^3\) e.g., fuel cells in EVs and other electricity storage systems