

IICEC - Sabancı University TIMES Energy Model (ISTEM)

During 2019 & 2020, one of the major IICEC projects was the new IICEC-Sabancı University TIMES Energy Model (ISTEM), a holistic energy model that particularly focused on the Turkish energy economy. The Model benefits from the MARKAL/TIMES modeling system, a combined engineering and economy modeling framework developed at the International Energy Agency (IEA) and is supported by additional modeling and analyses. ISTEM represents energy dynamics over a multi-period time horizon in the context of the Turkish energy economy. It relies on a comprehensive set of data and analysis that IICEC has been independently developing.

ISTEM includes comprehensive information about each and every aspect of a complete energy system: 1) Primary energy resources and technologies (including domestic supply, imports, and exports); 2) Energy conversion and transmission technologies; and 3) Energy services consumption and technologies (energy-using technologies in the residential, commercial, industrial, transportation and agricultural sectors).

Since a holistic and detailed energy-economy-technology model can provide for an overall and in-depth understanding of an energy economy, ISTEM is built on a Reference Energy System representing the whole energy economy with an advanced level of detail from primary energy supply until final energy consumption. This provides several advantages that make more extensive data collection and analysis effort a good investment. Based on policy objectives and relevant constraints, it provides an accurate prediction of what the Turkish Reference Energy System will look like in future periods since the modeling and analyses will already accommodate what is expected about future dynamics including energy policies, energy markets and technologies.

Contrary to analyses that rely on econometric trends to make longer-term projections, scenarios perspective serves as the only practical choice to estimate energy trends beyond a few years. An energy scenario provides a set of consistent assumptions that describe the main drivers of energy policy objectives, technology choice and energy use. This leads to a coherent organization and representation of the system under investigation.

Scenarios can reflect:

- Energy policies and strategies
- Primary energy supplies
- Energy service demands
- Current and future energy technologies across the energy value chain

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 and compare the possible energy futures based on various scenarios. Differences among scenarios can concern:

- Energy policies that would affect the energy sectors in a variety of ways,
- Future improvements in the cost or performance of energy technologies,
- The emergence of new energy technologies or associated business models,
- Changes in natural conditions that would affect the energy system,
- Many other factors

ISTEM provides many research opportunities. Observing the impact of regulations¹, technologies², and market players' configuration on each energy carrier, technology, and demand from primary energy supply through conversion until final energy services demand is a unique contribution proposed by the ISTEM.

ISTEM enables sector-specific analyses in a holistic perspective. Some examples include,

- In the power sector, the future of power generation mix under different scenarios and reflecting technology detail,
- A holistic perspective on any type of fuel from supply to final use, for example, the use of natural gas or coal,
- In the transport sector, electric vehicle development, modal shifts and future Turkish light vs. medium distillate demand with impacts on the Turkish refinery sector,
- In industrial and building sectors, the role of energy efficiency and current and new technologies in current and future demands.

¹ introducing new legislation or changing current ones

² such as a breakthrough in introduced technologies or adding new technologies that are not available before