LEAP – The Long-range Energy Alternatives Planning System

LEAP, the Long-range Energy Alternatives Planning System, is a widely-used software tool for energy policy analysis and climate change mitigation assessment developed at the Stockholm Environment Institute.

LEAP is an integrated, scenario-based modeling tool that can be used to track energy consumption, production and resource extraction in all sectors of an economy. LEAP is not a model of a particular energy system, but rather a tool that can be used to create models of different energy systems, where each requires its own unique data structures. LEAP supports a wide range of different modeling methodologies: on the demand side these range from bottom-up, end-use accounting techniques to top-down macroeconomic modeling. LEAP also includes a range of optional specialized methodologies including stock-turnover modeling for areas such as transport planning. On the supply side, LEAP provides a range of accounting, simulation and optimization methodologies that are powerful enough for modeling electric sector generation and capacity expansion planning.

LEAP is intended as a medium- to long-term modeling tool. Most of its calculations occur on an annual time-step, and the time horizon can extend for an unlimited number of years. Studies typically include both a historical period known as the Current Accounts, in which the model is run to test its ability to replicate known statistical data, as well as multiple forward looking scenarios.

LEAP is designed around the concept of scenario analysis. Scenarios are self-consistent storylines of how an energy system might evolve over time. Using LEAP, policy analysts can create and then evaluate alternative scenarios by comparing their energy requirements, their social costs and benefits and their environmental impacts. The LEAP Scenario Manager can be used to describe individual policy measures which can then be combined in different combinations and permutations into alternative integrated scenarios. This approach allows policy makers to assess the impact of an individual policy as well as the interactions that occur when multiple policies and measures are combined. For example, the benefits of appliance efficiency standards combined with a renewable portfolio standard might be less than the sum of the benefits of the two measures considered separately.

https://www.energycommunity.org/default.asp?action=introduction

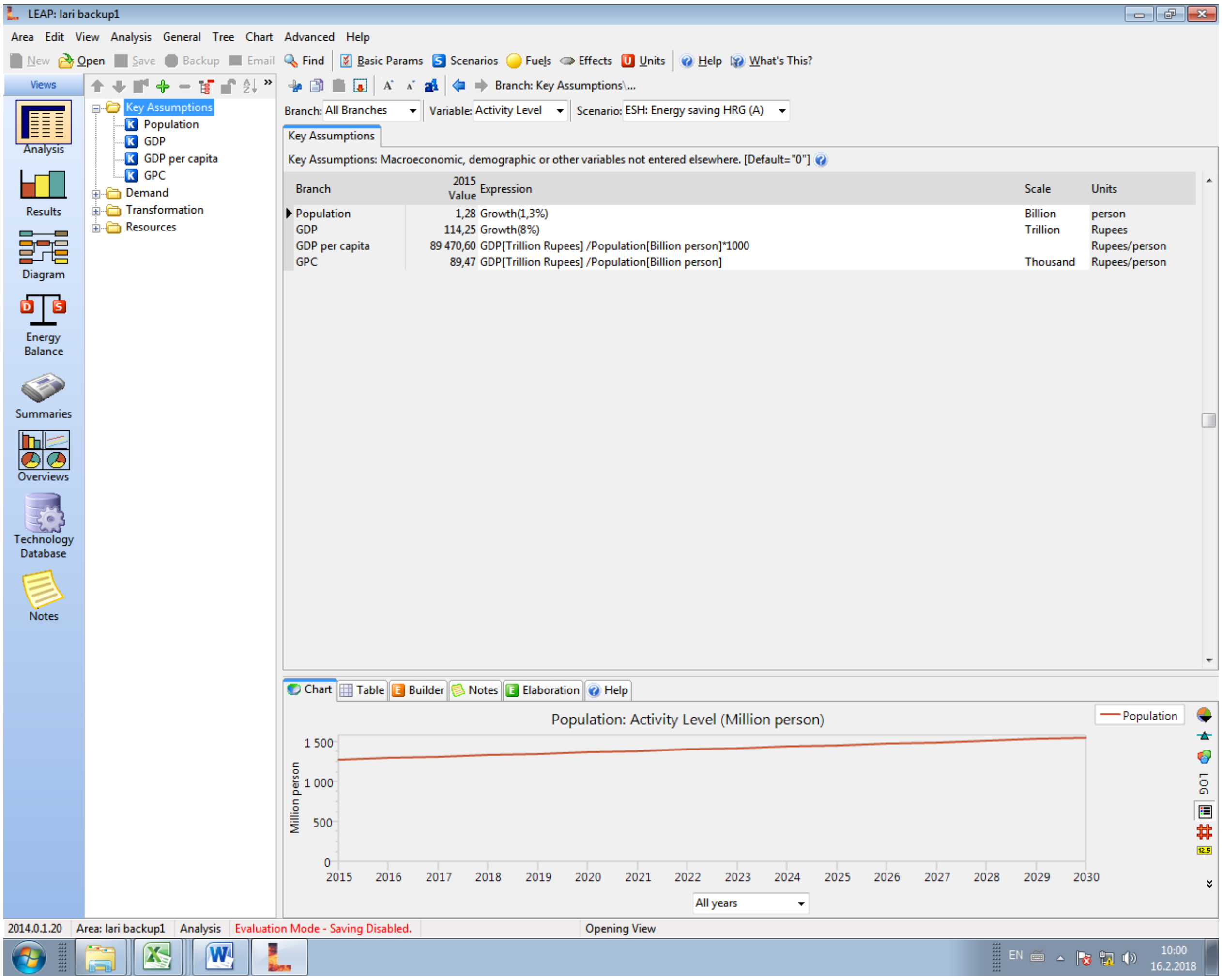

Figure 1: LEAP screen with the key assumptions.

The LEAP screen is divided into the Key Assumptions, Demand, Transformation and Resources. Apart from the Key Assumptions, the structure of the data is supposed to represent energetic mineral going from bottom to the top (Starting as raw sources in Resources, getting converted to electrical energy and distributed in Transformation and finally electrical energy consumed in Demand).

Key Assumptions hold data which is not directly connected with energy but has significance in the final demand of energy. The variables chosen are Population, GDP and GDP per capita. The initial and future values of these variables and the reason for choosing them are discussed in the manuscript. Base values for these variables are kept in the 2015 Values tab while future values are represented as expressions in the expression tab. The initial visualization for each variable is shown at the bottom of the screen (Population: Activity Level in Figure 1).

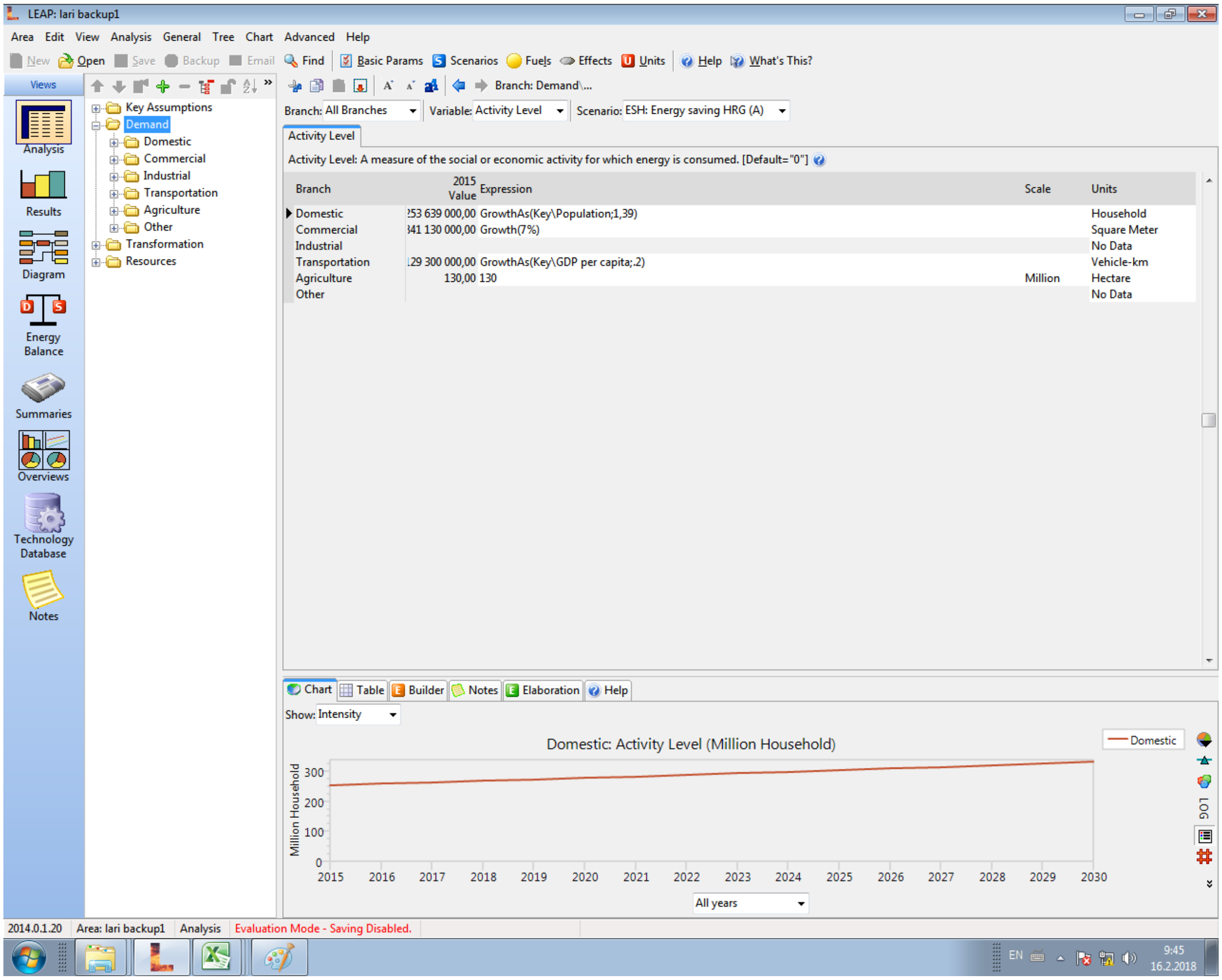

Figure 2: Demand tab shows the demand for each significant sector.

The overview of this tab shows the base and future activities for all the significant sectors together with their units. The sectors which are represented as ‘No units’ simply mean that they are too complicated to be represented by one unit and had to be expanded further.

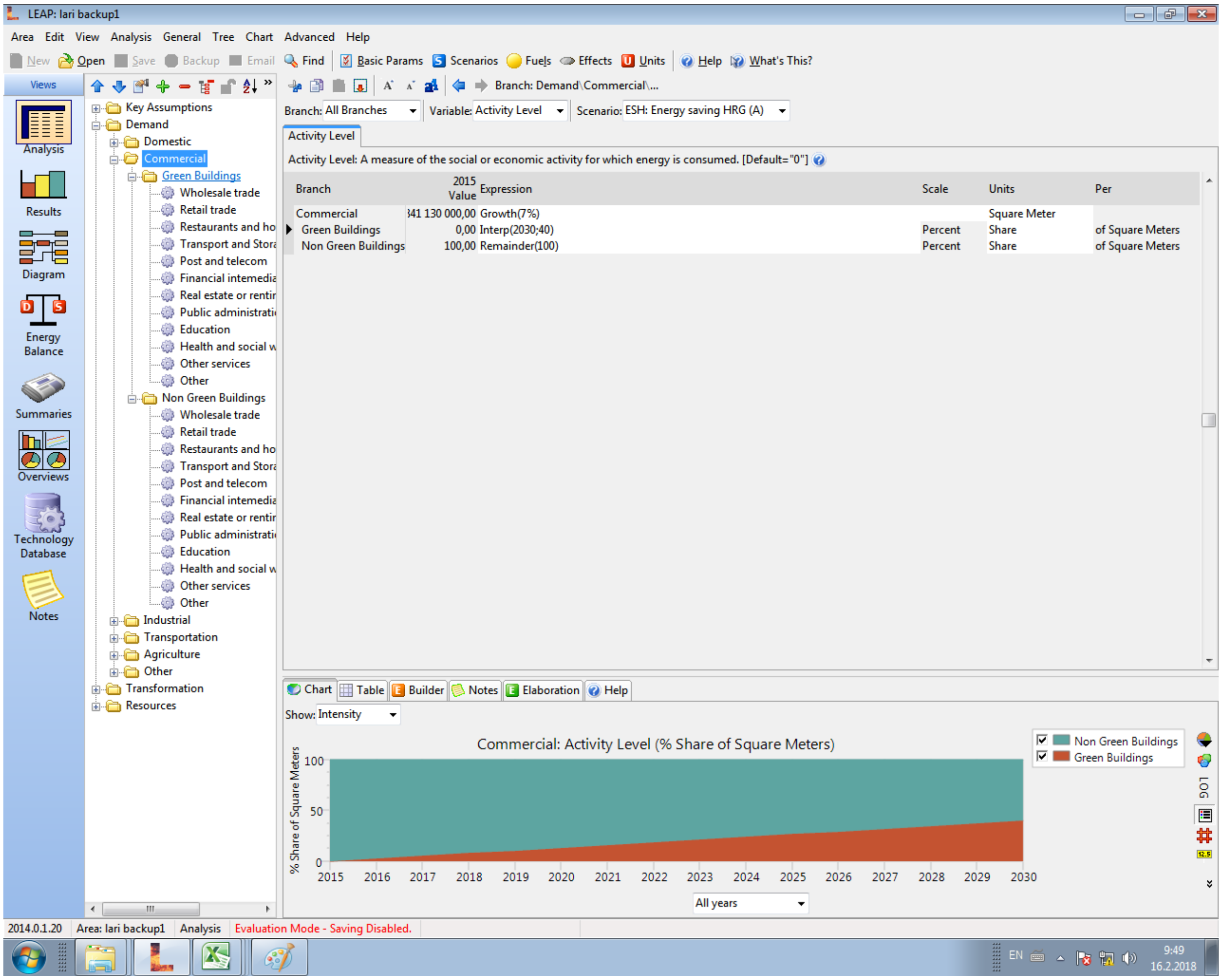

Figure 3: Commercial demand for electricity.

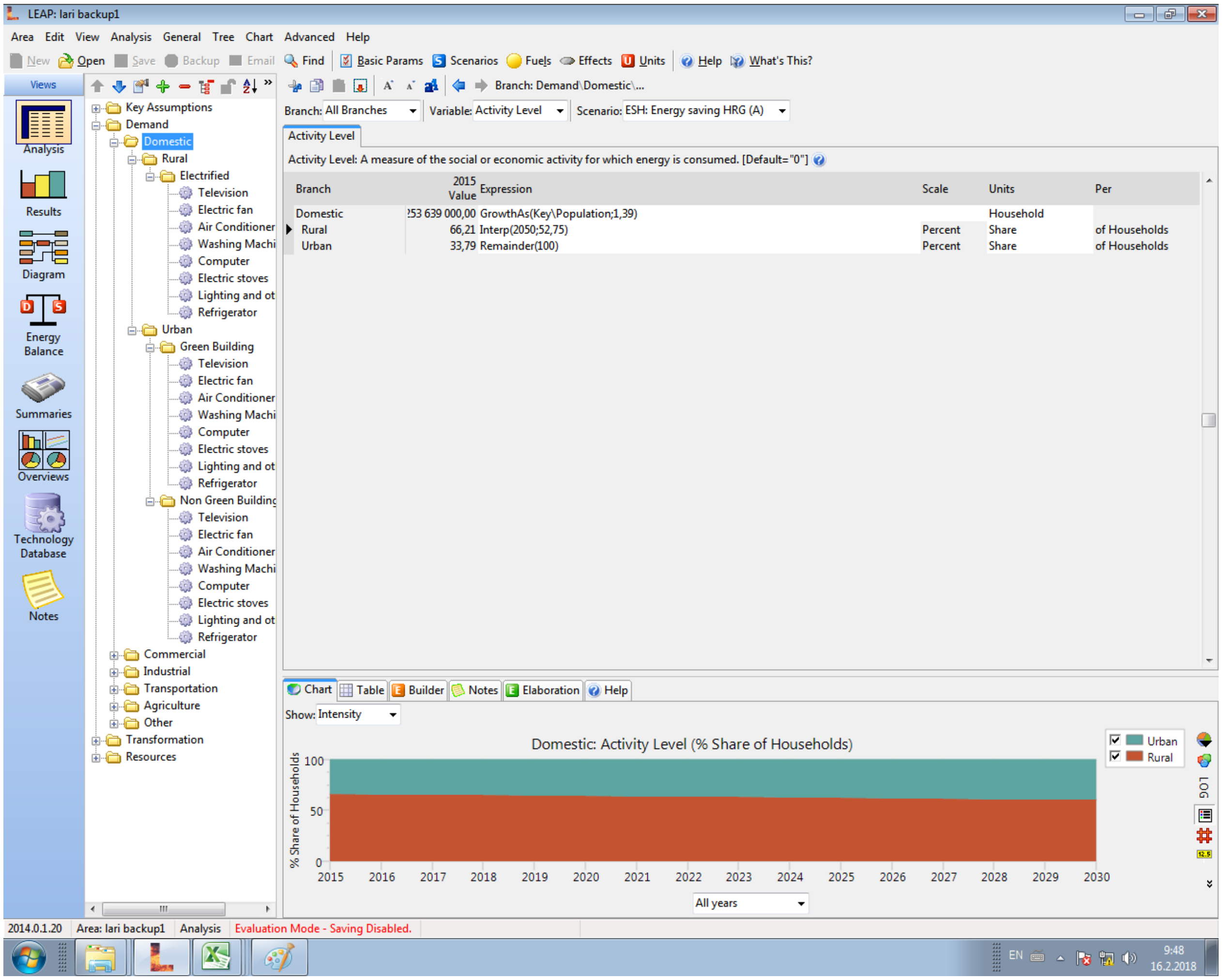

Figure 4: Domestic demand for electricity.

The forecasts for residential demand heavily rely on the NSS rounds survey mentioned in the manuscript. The data for the survey is also added as a supplement. For getting the forecast for future demand in the domestic sector, regression analysis was performed for each component (ownership of TV, AC units, Washing machines. Etc.) as independent variable together with the Key Assumptions of the model.

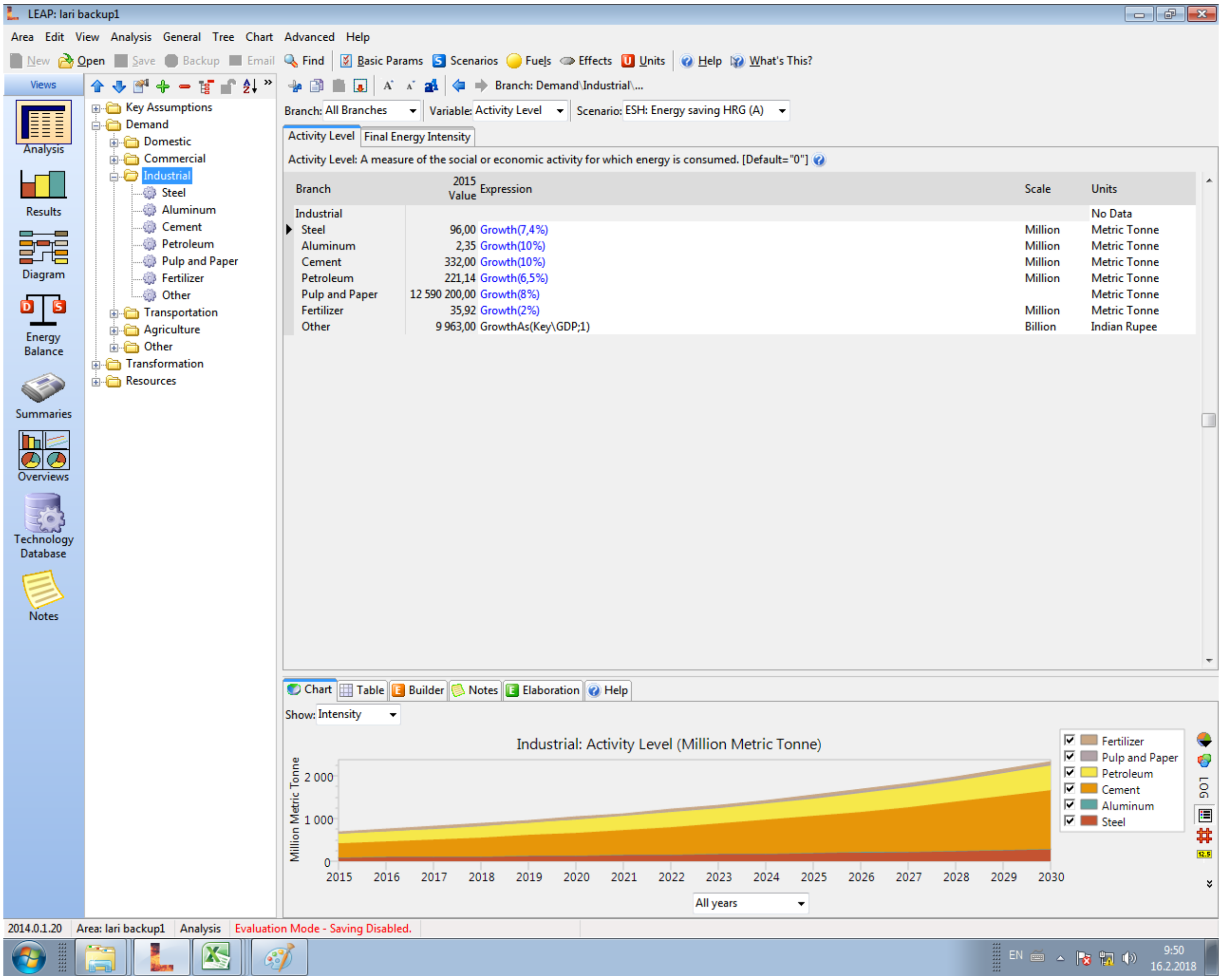

Figure 6: Industrial demand for electricity.

Industrial demand was divided to the major industries in India. The units for comparison for each industry are shown in the figure. Electricity consumption for each industry was calculated by comparing how much electricity/energy is required to get 1 unit from that industry. These expressions are discussed in the manuscript. They are shown in Figure 7.

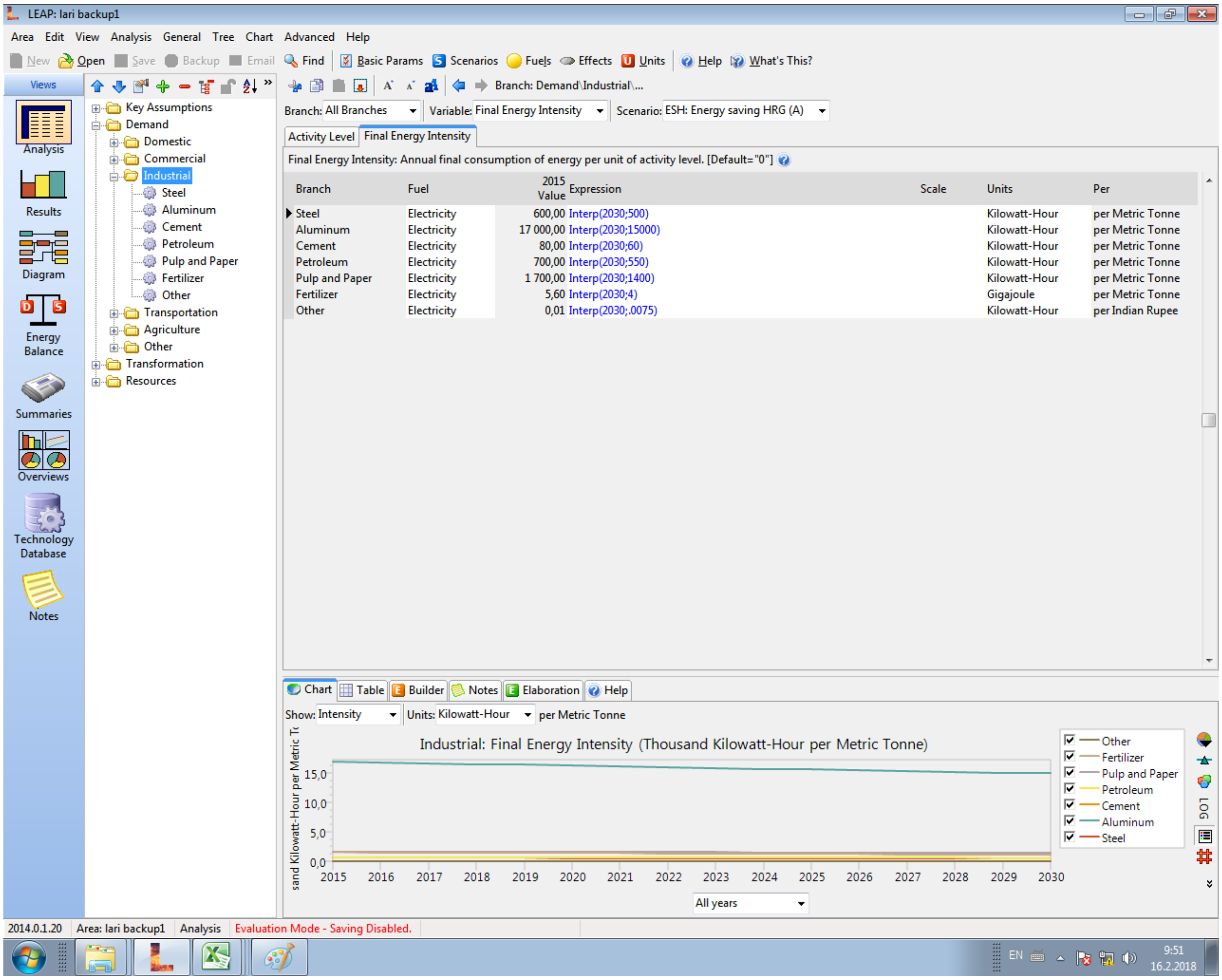

Figure 7: Electricity intensity for each industrial sector.

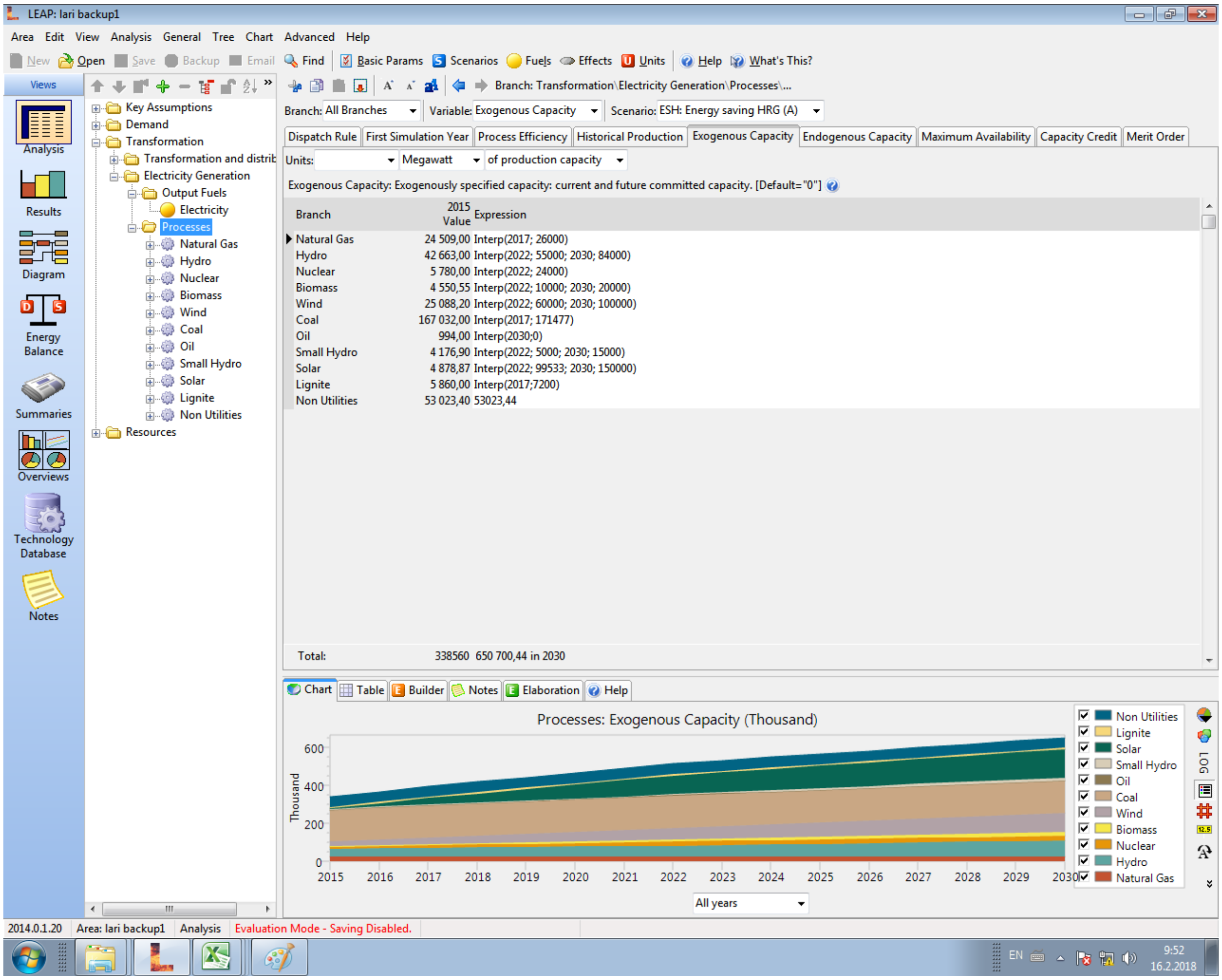

Figure 8: Electricity capacities from different sources (Current and future estimates).

These current capacities are discussed in the manuscript. The exogenous component represents capacities which have been planned by the government as part of their overall energy policy and strategies. These were mentioned in the manuscript.

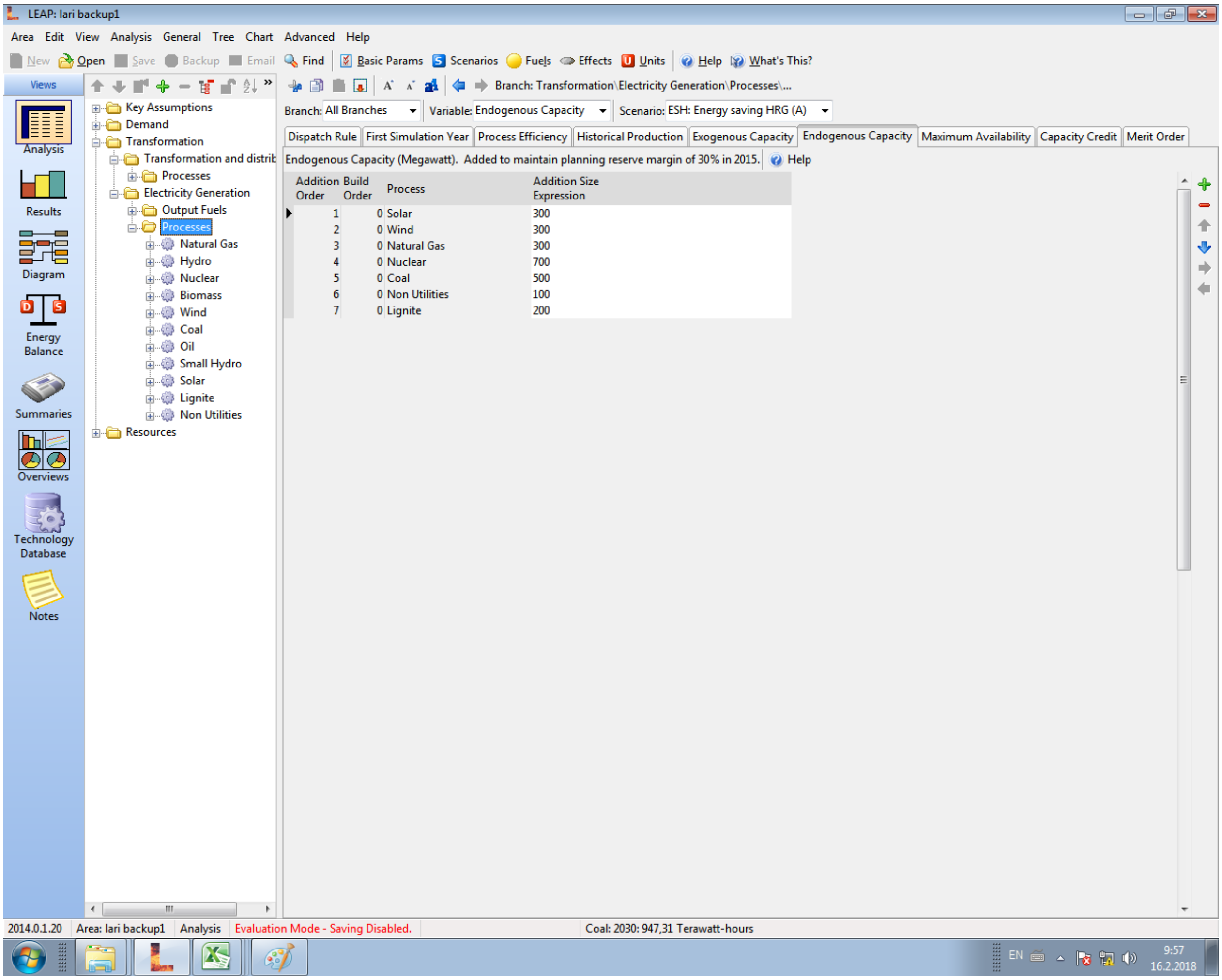

Figure 9: Endogenous capacities for high renewables and natural gas.

These capacities represent capacities which are outside the time frame of the energy policies/strategies of the government which were mentioned. Most of the plans mentioned in the manuscript were up to 2022. The endogenous tab is used to explore the situation for post 2022. In the scenario presented in figure 9, the renewable energy sources are preferred over the conventional sources. The model would choose from top to bottom. For the opposite scenario where high growth and conventional sources are preferred, the table is also opposite.