EcosimPro is a powerful simulation environment capable of modelling any kind of dynamic system represented by differential-algebraic equations (DAE), ordinary-differential equations (ODE) and discrete events. It is based on very powerful symbolic and numerical methods capable of processing complex systems of differential-algebraic equations. With its clever wizards, EcosimPro provides modellers with an easy way to build consistent mathematical models.

EcosimPro has an advanced Graphical User Interface and uses a high-level, “engineer-friendly” object-oriented and non-causal language (EL) for creating reusable libraries of components.

Models can be constructed graphically by ‘dragging-and-dropping’ the required component symbols from the included libraries to a schematic window. Using EL, users can also create new components and libraries, or extend the existing ones.

EcosimPro is used by leading companies in the Aerospace and Energy sectors. European Space Agency (ESA) has chosen EcosimPro as its recommended tool for simulation in several fields, including propulsion, environmental control systems and life support, and power systems.

PROOSIS
PROOSIS is a simulation tool based on EcosimPro and developed in close collaboration with the European aerospace industry and academic institutions. PROOSIS keeps all the simulation power of EcosimPro and adds extra capabilities for modelling gas turbine engines and other related systems: single or multi-point design and off-design calculations, sensitivity analysis, inequalities, turbo-machinery map handling, etc.
**MAIN FEATURES**

- **EL modeling language** for the creation of new components and libraries. This non-causal approach allows the modeling of concepts that have not been considered before in existing solutions. Its object orientation allows developing extendible and easy to maintain libraries. Thus, EL and PORTTRAN functions can be called from the EL language, and interaction with XFL files is easy through the XFL parser.

- The symbolic mathematical kernel automatically extracts the mathematical model from the graphical schematics. The user selects the governing input variables (e.g. opening line) and the internal algorithms generate robust symbolic mathematical models through un-ordering. The tool also allows selecting any iterative variables when non-linear equation systems are formed. This provides valuable information about the mathematical problem to be simulated by the solvers.

- The available internal solvers deal with stiff or non-stiff dynamic problems (DAESS, RIKS and Adams-Moulton). The algebraic problems are tackled by an improved Powell’s hybrid based method. Convergence issues can be addressed with the help of the simulation log, in which the evolution of the variables, residues, simulation errors and statistics are demonstrated.

- Common calculations, such as transient and steady simulations, parametric and optimization calculations can be quickly configured through the extensive graphical experimental wizards. Any type of calculation can be performed using EL language.

- Models and calculations can be encapsulated and encrypted in a stand-alone application (deck) with user defined attributes. The deck can be used in command line mode, through a graphical user interface, or integrated into C or PORTTRAN applications by means of standard interfaces (SAFE 4968 and SAFE 45191).

- Moreover, with the EcoSimPro toolbox for Hs Excel, models can be directly integrated into stand-alone spreadsheets.

- It is also possible to interact with PROGIS models from MATLAB. Furthermore, the model can be exported as an encapsulated S-Function block, which means it is possible, for example, to develop the engine with EcoSimPro and the control system with Simulink.

- A model can also be exported ready to be used in a HIL system through Simulink. Or it can be connected to SCADA, other models or hardware using OPC technology.

- EcoSimPro offers a platform for collaborative work within and between companies. The included source code environment (control system (SVN) integration allows tracking and managing all changes to libraries, models and calculations made by any user. The deck exporting and external tools integration allows safe sharing of models between companies.

**APPLICATION FIELDS**

- **Power Systems**: EcoSimPro includes a set of standard libraries for general power plants and for specific types of calculations:
  - **Power and electrical systems**: thermal control, AOCS simulation, etc.
  - **Thermal networks**: renewable energies and smart grids

- **Space Systems**: Several off the shelf libraries are available for the simulation of space applications:
  - **ESPSS (European Space Propulsion System Simulation)**, a state of the art tool for modeling rocket engines validated by the industry through extensive tests
  - **Environmental Control and Life Support Systems** including typical phenomena and equipment such as cabins, crew, heat exchangers, pipes, chemical reactors, etc.
  - **Power and electrical systems, thermal control, AOCS simulation, etc.**

- **Power Plants**: Several off the shelf libraries are available for all sort of analysis of industrial gas turbines and power plants:
  - **Fluid analysis of complex systems linked to heat transfer processes and control diagrams**
  - **Thermal balance studies of cycles in the operation of power plants**
  - **Industrial processes such as chemical reactions, distillation, evaporation and boiling, etc.**

- **Other applications**:
  - **Gas turbine systems (only in PROGIS):** simulation of any gas turbine configuration together with its auxiliary systems such as fuel supply or lubrication
  - **Cryogenic systems:** dynamic simulation of large cryogenic installations
  - **Tritium:** transport phenomena and physico-chemical processes related to the extraction and purification of tritium for Fusion Nuclear Energy
  - **Desalination systems:** reverse osmosis process and thermal desalination
  - **New incoming applications under development such as renewable energies and smart grids**

**BASIC CONCEPTS**

The development of libraries requires a user (Level 1) expert on the mathematical representation of a model, in order to encapsulate it in a stand-alone application (deck). Several off the shelf libraries are available for all sort of fields:

- **Power Plants**
  - **ESPSS (European Space Propulsion System Simulation)**
  - **Environmental Control and Life Support Systems**
  - **Power and electrical systems, thermal control, AOCS simulation, etc.**

- **Space Systems**
  - **ESPSS (European Space Propulsion System Simulation)**
  - **Thermal networks**: renewable energies and smart grids

EcoSimPro is a powerful tool with a wide range of applications.