



# RECURSOS PEDAGOGICS PER A LA SOSTENIBILITAT I COMPROMÍS SOCIAL

Grup d'Educació per a la Sostenibilitat en l'Enginyeria de Sistemes, Automàtica i Informàtica Industrial

GES2AII, UPC

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**ABSTRACT-** This project consisted mainly in the creation of a repository for pedagogical resources based in the Sustainability and Social Commitment. Those resources consisted on a set of mathematical models that represent real systems that have been modelled and their behaviour has been simulated along the time. For every resource, there is a theoretical introduction in which the problem is explained and its mathematical model is derived in algebraic and/or ordinary differential equations. For every resource, its block diagram, input and output variables are also shown and explained as well as the relationship among them. Apart the model theoretical section, the model has been implemented with all its equations using a specific simulation software (EasyJava Simulations) in order to show its evolution along the time, allowing the modification of different model parameters, giving some interaction with the user and a feedback in the dynamic model evolution. This way of implementing and presenting the models, their theoretical framework and their simulation will be a very useful tool for lecturers that teach subjects about "Simulation and Modelling of Dynamical Systems" as well as for students. Regarding the lecturers, the result of this project will be an additional tool in the masterclasses, complementing the blackboard explanations and the digital presentations, because the dynamic evolution of the model could be presented to the students. Regarding the students, each resource will be the statement for a practice in the "Simulation and Modeling" subject, because they will find all the formulation to program and implement the model as well as the results of the simulation that will allow to compare their results. In summary, the objectives of the project have been completely achieved, building a repository of pedagogical resources based in models of sustainable cases.

## Motivation

**Greening Education:** In the last years society has become aware of that the pattern of current development affects our Planet in a noxious way. Particularly, in the Mediterranean region the climate change effect will be the decrease of water supply, causing a higher health risk and a decrease of hydroelectric energy generation. In order to not increase the use of nuclear energy generation neither the primary energy production coming from burning fossil fuels, there is the necessity of shifting to the generation of renewable energy to help meet increased energy needs. Education and Training play an important role in the sustainable production of renewable energy (solar, wind, tides, geothermal, biomass...) as well as in a rational use of this energy (consumption reduction, effective energy transport, efficient grid system...).

**Distance Education:** In our modern society, distance education has become a viable solution for students who require more flexible, accessible, and adaptive teaching systems, without spatial and temporal restrictions.



Innovative Web-based Pedagogical Tool Environment

## MODEL.UPC.EDU

This innovative didactic tool, the MODEL web, is a compilation of sustainable modeling education resources, specifically a virtual laboratory. The virtual laboratory is made up of models in the following typology:

- Aquatic systems
- Water management
- Human and social development
- Sustainable environments and populations
- Greenhouse gases
- Renewable energies

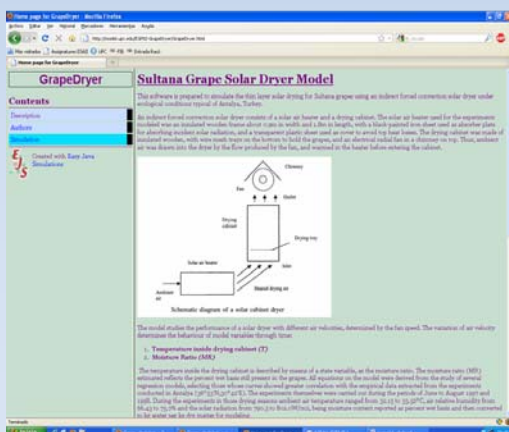


## Simulation and Modelling of Renewable Energy Systems Course

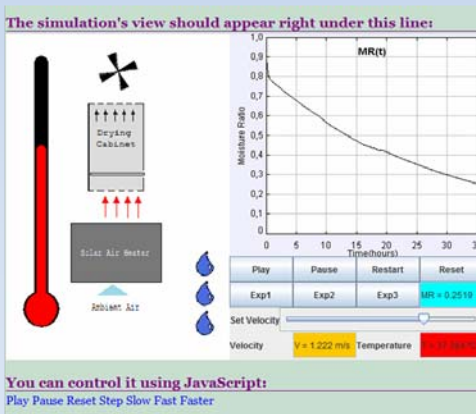
In this course the dynamic and interactive simulations in a stand-alone or Web-based environment is used: a Virtual Laboratory. The proposed laboratory practices about renewable energy are developed at the Industrial Engineering degree at UPC, consisting on the use of a virtual laboratory based on the Easy Java Simulations tool. This innovative university training has as main objective to transmit theoretical concepts, skills and attitudes in order to the students take into account the sustainability and greening solutions (energy saving, efficiency improving of energy use, CO<sub>2</sub> emission reduction, and recycling and life cycle assessment) as future professionals in Engineering. Specifically, the objective of this laboratory is to implement and test models related with Sustainability and Renewable Energies.

### A Sample Example: Sultana Grape Solar Dryer

#### Statement



#### Expected Simulation Results



Teaching staff have an initial task of preparing the contents of the practice, and it consists on the following steps:

- To develop the model of the real system by physical or empirical equations.
- To implement the model with the Ejs in order to verify the equations, and propose a specific view.
- When the above steps are perfectly done and the view is attractive enough, it is necessary to create a web page with the output of Ejs.

Visit the Pedagogical Web:  
**MODEL.UPC.EDU**