

## UTC-1702E: Thinking in Systems-Energy Systems

### Mini-Project-2 – Small Group Activity

(To scaffold your learning through Week 8 activities)

**Topic: Modeling Coal- and Oil-based energy systems for Electricity: Comparing the impact on other systems (electricity production, carbon emissions, GDP and Population etc.**

**(This assignment is based on Week-8 modeling activity discussed in class for Oil-based system)**

#### Learning Outcomes

- (i) **Apply systems thinking tools and modeling concepts** to construct and simulate SFD using Vensim modeling tools.
- (ii) **Expand/modify the model boundary and construct new SFD.**
- (iii) **Quantify the new variables and formulate** the model with those new measurements and compare
- (iv) **Interpret the model behaviours** in terms of the impact of changes made.
- (v) Perform **what-if or sensitivity analysis** and suggest **possible policies**.
- (vi) **Cooperative and collaborative learning in small groups: Interact with peers** in your groups to **effectively communicate** ideas, mental maps, problems and solutions through the language and tools of system thinking.

**Modeling Tasks: This is a group activity and complete the tasks while working in groups for effective learning from each other**

**Task-1 Remodeling/constructing the SFD incorporating a ‘Coal’ resource system in the place of ‘Oil’.**

**Completely change the energy resource sector to Coal system** which is another fossil fuel resource. **Modify the variables accordingly by shifting to Coal.** Reconstruct a new SFD by replacing all variables in the previous model related to resources and energy with coal system wherever necessary (i.e. replace Oil system with coal system). **NOTE:** As you replace oil system with coal, coal will be used for energy/electricity production. Hence, re-estimate and quantify all energy related variables, conversion factors and also amount of carbon emissions from coal.

**Researching for New Data for Coal system:** search for new data to reformulate the variables, values, units and their calculations with respect to burning fuel, energy production, carbon emissions etc. resulting from Coal. You can search internet for the energy data about coal and energy conversions, emission from burning coal etc. Complete the formulation of the model in Vensim using those values for coal and with proper units. Some of the useful resources for energy related information and data are given below:

<https://www.iea.org/fuels-and-technologies>

<https://www.eia.gov/tools/a-z/index.php?id=c>

**Feel free to add any new variables if you need to do so while transferring the model from Oil to Coal system.**

### **Task-2 Formulating the SFD with 'Coal' system**

- After formulating the SFD for coal, simulate the base model after checking all units, and model. Observe the behaviour of key stocks and variables.
- Compare the results with that of the previous model with Oil as a resource.

### **Task-3 What-if analysis or sensitivity analysis**

- Perform sensitivity analysis mainly to cut-down carbon emissions. What are the parameters to be adjusted to achieve it?
- Save the simulation data file for this sensitivity analysis.

### **Task-4: Writing short report containing the following:**

- Aim of the modeling task
- Rationale for modifying the model
- Discussion of simulation results of the coal model along with BOTGs of key stocks and variables.
  - Comparative discussion
  - Discuss briefly the impact of using Coal, instead of Oil, on available energy reserves, population, environment and economy
  - Support your discussion with appropriate graphs from both models for comparison.
- Sensitivity Analysis Results
  - Discuss briefly the result of sensitivity analysis performed in Task-3 and propose the policies to cut-down the emissions and to control death rate. Insert supporting BOTG for this.

### **Submission items (due date by Wed in Week-10)**

- Submit the Coal model and simulation files of both base model and also sensitivity analysis files in a single folder.
- Name the folder according to your group and submit it under your group on Luminus
- Group Report: Prepare a document as a short report by including the headers as indicated in Task-4