

Energy Resources, Economics and Environment
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Lecture 4 P1
Introduction to Country Energy Balance assignment

Hello, I am Santnam Bakshi, a teaching assistant of the Energy Economics Resources and Environment course, I am going to walk you through the Country Energy Balance given to the students. The objective of this assignment was for students to construct an energy balance for different countries, to see the flow of energy from the primary sources such as coal and oil to secondary sources like electricity to the final end uses.

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3. **Contents of the report:** The report must contain the following:

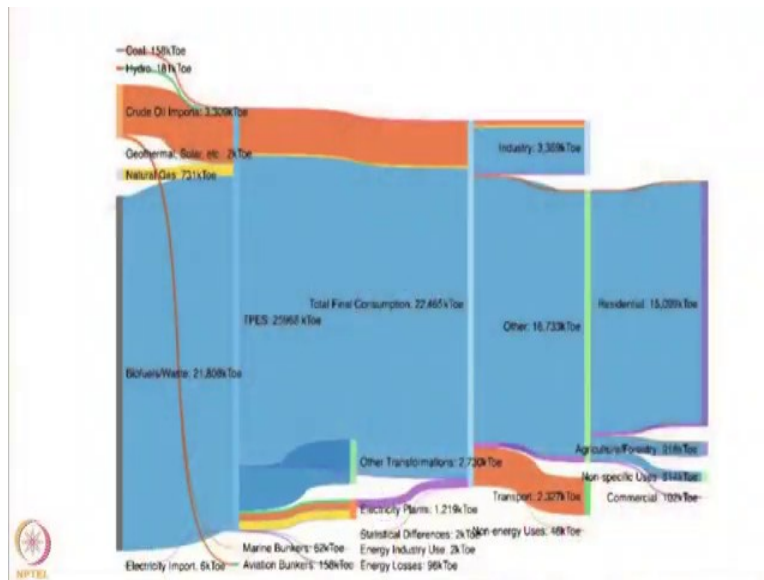
- Data source (must be written very clearly, in appropriate format)
- Energy balance table for the country (as shown in the figure given below) [Units for energy must be PJ]

Primary Energy		Secondary Energy		Sectoral Energy Consumption		End Use Energy Consumption	
Parameter	Value (PJ)	Parameter	Value (PJ)	Parameter	Value (PJ)	Parameter	Value (PJ)
Source 1:	Coal	Electricity		Residential		End Use 1	
Production		Production					
Import		Import				End Use 2	
Export		Export					
Source 1							
Total		Total				End Use 3	
Source 2:	Crude Oil	Oil Products		Industrial		End Use 1	
Production		Production					
Import		Import				End Use 2	
Export		Export					
Source 2							
Total		Total					
Source 3:	Nuclear	Heat				End Use 1	
Production		Production					
Import		Import		Transport		End Use 1	
Export		Export					
Source 3							
Total		Total				End Use 2	
Source 4:							
Production						End Use 3	

As you can see in this slide, we asked them to construct a table, which shows the different sources that are there. The students were asked to collect data for different countries of their primary energy uses, and the amount of energy that goes into secondary sources like electricity, there uses in different sectors like residential, industrial and transport and their break up into different end uses like lighting, air conditioning, extra.

A lot of this information can be found on the website of the International Energy Administration, as well as the United States Energy Information Agency.

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So, moreover we asked the students to construct a Sankey diagram with this information, The Sankey diagram is a very good way to represent the flow of energy from primary sources to secondary energy all the way to end uses and in different sectors. As you can see in this particular diagram, it is very clear where the losses are and what the magnitudes of different things are.

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e. Compare the energy mixes for the country in **2000 and 2015** using the **Sankey diagram** and the **PECSS diagram**. Based on this, identify the significant changes that have taken place in the country.

f. Collect data to calculate the short term (2010-2015) and long term (2000-2015) compound annual growth rate for the **population, GDP, primary energy use, import/export of energy, CO₂ emission, installed power, GDP per capita and emission**. Calculate using the **Kaya identity** the different indicators relating to emissions in the country and comment on the implications of this change. Compare these parameters with those for India and the world in the same time. Comment upon the energy security of the country. What is the implication of the energy/energy product export of the country on its economy? What is the share of renewables and nuclear energy in the country? How does this affect the emissions in the country?

g. Highlight the significant policies that have been undertaken by the country to reduce energy consumption and energy related emissions or pollution. Comment on the barriers to implementation of these policies as well as the bottlenecks imposed by them. Conclude the report with what this country can learn from India and what India can learn from this country. What challenges do you anticipate for this country going forward?

4. **Mock UN:** In the mock UN setting, each country will be required to present the data collected in the course of the assignment as a 4 minute powerpoint presentation. Based upon the presentation and the report, other countries will pose questions to identify the strengths and weaknesses of the countries that have been allotted for 3 minutes. The exact format of the mock UN will be given to you at a later date.

5. **Plagiarism:** Plagiarism is defined as the act of passing someone else's work off as your own, without giving due credit to the person. Plagiarism of any form in the report (a similarity index of greater than 20 %) will attract penalties. Students will be required to submit their report on the platform Turnitin. A separate guide to getting and using Turnitin will be made available to you. Styles that must be followed for references of websites and papers will be provided to students.

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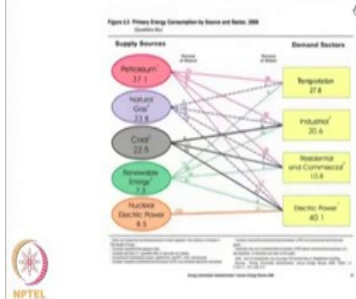
a. **Sample reference styles:**

- i. For an article in a journal: name of the authors, title, name of the journal, volume /issue number, range of pages, and year.
Example: Bandyopadhyay S, Bera N.C. and Bhattacharyya S. 'Thermoeconomic Optimization of Combined Cycle Power Plants', *Energy Convers. Mgmt.* 42(3): 359-371, 2001
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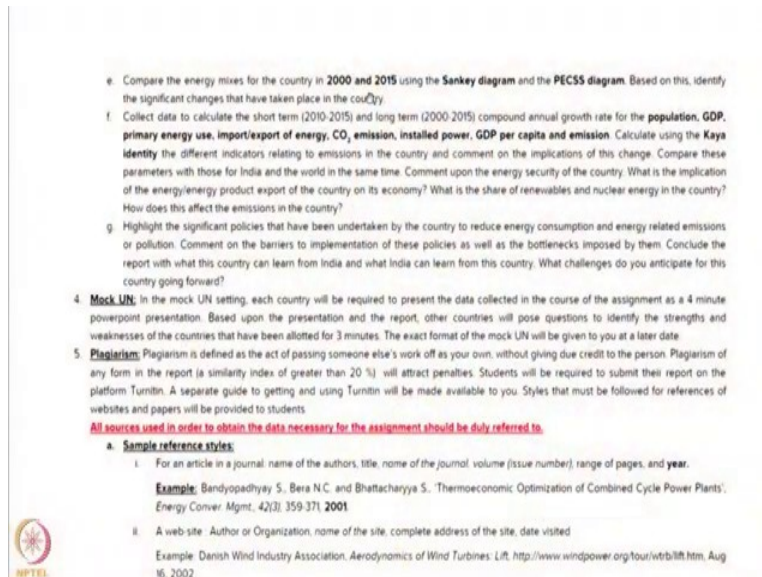
Total									
Source 5									End Use 2
Production									
Import									End Use 3
Export									
Source 5									
Total									
All Sources									
Total									

- c. Sankey diagrams are a specific type of flow diagrams, in which the width of the arrows is shown proportionally to the flow quantity. They are excellent tools to visualize national level energy flows between various sectors. Students may use the online resource <http://sankeymatic.com> in order to create the same. An example Sankey diagram for Tanzania has been shown on the next page, constructed on the same resource. **Screenshots of the Sankey diagram, if present in the report will be penalized.**
- d. PECSS diagram: **Primary Energy Consumption by Source and Sector diagram**



After this, we also asked the students to construct a PECSS diagram which stands for Primary Energy Consumption by Source and Sector. So, this gives a very clear understanding of what the different primary energy sources are, what are their contributions to the energy requirements of that particular country and what their different breakups are in terms of the usage.

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4. **Mock UN:** In the mock UN setting, each country will be required to present the data collected in the course of the assignment as a 4 minute powerpoint presentation. Based upon the presentation and the report, other countries will pose questions to identify the strengths and weaknesses of the countries that have been allotted for 3 minutes. The exact format of the mock UN will be given to you at a later date.

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The students were asked to construct these diagrams for two different periods of time, 2000 as well as 2015. This was to illustrate the changes in the energy flow of a country over time, as newer technologies are developed. After this, they were asked to collect data on the different energy related metrics for a country.

We had them collecting the carbon intensity, which is the CO₂ emissions per unit energy produced, the energy intensity, which is the energy required per unit GDP, as well as the GDP per capita. In the assignment, our class was divided into different countries, there was a large variation in the countries ranging from the developed countries like the OECD countries, as well as the underdeveloped countries like some of the African nations. The idea behind this was for the students to understand how the variations in energy flow happens across the wealth of different countries.

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The students were further asked to collect information about the energy imports of a country and its implications on the energy security of the country. Students were also requested to collect information on the policies of individual countries, that they had committed to, to meet the Paris Climate Agreement. We also asked the students to find out what are the bottlenecks that these countries face in implementation of these policies.

We now have three different countries presenting to you. They are Mexico, Australia, and Japan, you can get an understanding of the information that the students found about these three different countries, and what their scenarios are. Thank you.