Lesson1: energy accounting

1. Defining energy accounting:

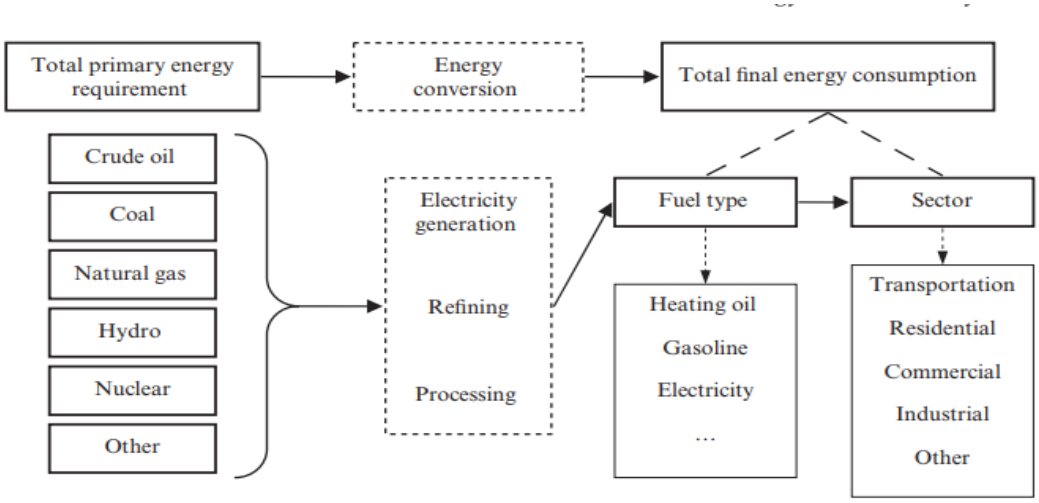
Energy accounting is a branch of accounting that applies economic theories and methods to manage and control energy costs, spend on pollutant prevention and treatment, and energy conservation and emissions reduction benefits. It is essential for coordinating economic development and environmental protection.

Energy cost is expressed as the number of energy units per unit of the commodity e.g. mega joules per kilogram. Traditional costing methods often ignore indirect energy costs associated with plant construction.

Energy accounting was defined in 2000 as a system for recording, analysing, and reporting energy consumption and regular cost, which is critical to energy management and cost savings. In 2020 it was defined as an information system used to calculate, analyse and transmit energy use daily in the facility's activities. The objective of this system is to improve the energy efficiency of the facility as well as to monitor the environmental impacts of all types of energy consumption activities.

The energy accounting framework enables a complete accounting of energy flows from original supply sources through conversion processes to end-use demands, avoiding double-counting and providing an exhaustive accounting for itemizing the sources and uses of energy. The energy flow considered in this framework is indicated in Fig. 1.

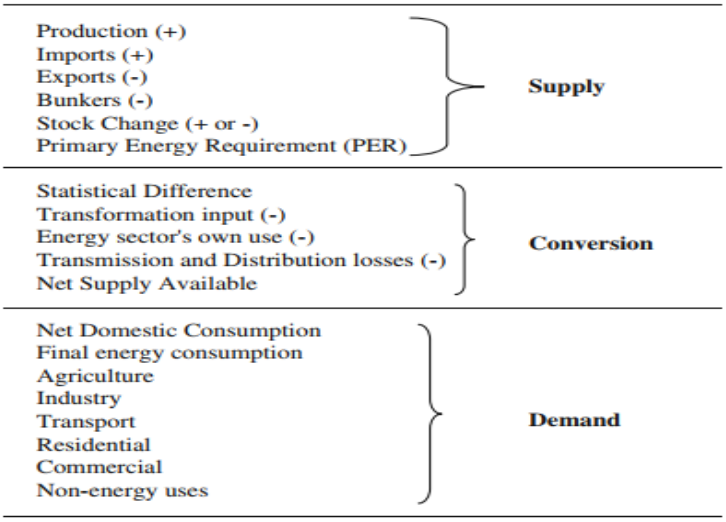
Fig. 1: **Typical structure of energy balance**



Normally the framework is applied to each individual fuel or energy type used in an economy and thus the energy account is essentially a matrix where:

- Each type of fuel is considered along the columns. The columns are chosen based on the importance of energy commodities in the country under consideration. More diversified the energy system, more detailed accounting is required.
- Each row captures the flow of energy. The rows are organised in three main blocks to indicate the supply of energy, its transformation and final use (see Fig. 2).

Fig. 2: **Main flows considered in energy accounting**



2. **Commodity accounts and overall energy balance:**

The Energy Commodity Accounts (ECA) and Commodity Accounts (OEB) are two key accounts used to track energy transactions for various energy sources.

- **Energy Commodity Accounts (ECA):** This shows all the flows in the appropriate original unit of measurement (tons, barrels, cubic meters, etc.). Normally, each energy producing, transforming and distribution industry has its own particular way of presenting statistics on its activities according to the purposes for which it needs data. The columns of an ECA cannot be directly compared or summed up because of differences in the units.
- **Overall Energy Balance (OEB):** This shows all the flows in terms of a common accounting unit (like Joule, kilocalories, Btu, etc.). The ECA is the starting point for an overall energy balance and using appropriate conversion factors, a suitably designed overall energy balance can be developed from it.

☜ **Note:**

The development of an effective energy policy requires annual energy balances to track its evolution and compare it with other countries of similar economic status. This necessitates a harmonized accounting framework to bring together all available energies for spatial and temporal analyses. Using a common unit of measurement is crucial for constructing the energy balance.

3. **Functions of energy accounting:**

- **The function of managing and controlling energy costs:** This function includes managing and controlling the cost of energy consumption within the economic unit, using modern tools and technologies, investing in energy, and using advanced management methods to achieve energy efficiency goals.
- **Energy expenditures and the prevention and treatment of pollutants:** Requires providing stakeholders with information on economic, environmental, and social benefits offered to society as part of the company's commitment to sustainable development and energy efficiency.
- **The function of saving energy benefits and reducing emissions:** Involves disclosing information on the company's investments in pollution management and prevention, as well as providing information on the benefits of environmental protection activities and reducing the level of energy consumption emissions.

4. **Components of the Energy Account:**

An energy balance table has three main building blocks:

- **Supply primary production:** it covers all production operations in a given territory: extraction of coal, oil, gas or generation of hydraulic, nuclear, wind electricity. Added to this is the net balance of trade (imports - exports of these same energy sources). International transport, both maritime and air (bunkers), is not included in the supply of a given country; changes in stocks during the year in question are added or subtracted according to the sign preceding them. The total supply is qualified as gross domestic consumption (GDC) or total primary production or total energy requirements (TPER) or total primary energy supply (TPES).
- **Transformations:** The supply of energy is transformed to produce derived (or secondary) energy. In accounting terms, inputs are negative, unlike outputs. Common transformation processes include oil refining, electricity generation, gas separation and conversion, and coke production from coal. The conversion section also captures information on energy used by the energy industries and transmission and distribution losses. The energy sector's own use refers to the energy used in the production process, while transmission and distribution losses represent waste in the delivery system that cannot be eliminated altogether.
- **Final consumption:** In terms of accounting balance, this is the residual amount available for domestic consumption after conversion. Final consumption includes non-energy and energy final consumption, categorized into industry, transport, and other sectors.

5. Energy accounts types:

The energy accounts comprise three types of accounts:

- **Physical supply and use tables for energy:** Compile and present all energy flows within a national economy in a common unit, aiming to be comprehensive and record all energy flows within and between the economy and the environment.
- **Monetary supply and use tables for energy:** Articulate energy flows in monetary terms between different economic units and record only those related to energy products.
- **Asset account for mineral and energy resources:** Aim to record the opening and closing stock of known assets and various types of stock changes, including mineral and energy resource assets held as inventories, to assess the depletion and degradation of available mineral and energy resources and assist in the management of energy from natural inputs.

6. Importance of energy accounting:

Energy accounting is essential for several reasons, including:

- **Saving costs:** By tracking and measuring energy usage, businesses can identify where there is energy wastage and enforce measures to decrease consumption. Save more money by doing this!
- **Enhanced energy efficiency:** Energy accounting helps organizations understand energy consumption patterns, spot inefficiency areas, and implement strategies to boost all-around energy efficiency.
- **Reduced carbon footprint:** Energy accounting helps organizations reduce their carbon footprint by recognizing ways to reduce energy consumption and shift towards more sustainable energy sources.
- **Compliance:** Since companies need to track and report energy usage, energy accounting can help them to meet these requirements and avoid penalties.
- **Transparency and accountability:** Energy accounting provides organizations with energy consumption data and insights on how to improve operations, track their progress, and set energy reduction targets, leading to transparency and accountability.
- **Sustainability:** Energy accounting is vital for organizations to implement sustainable energy management practices, which reduce their environmental impact and contributes to a more sustainable future.

7. The energy accounting process:

The energy accounting process is the organized and systematic approach to tracking, measuring, and analysing energy usage within a particular system or organization.

The energy accounting process commonly involves six steps:

- **Step 1: Collecting data:** the first step includes measuring the energy consumption for different systems and equipment, such as lighting, heating, cooling, and appliances. This data is collected using energy meters, building automation systems (BAS), building management systems (BMS), or energy management software.
- **Step 2: Energy consumption analysis:** after data collection, it needs to be analysed to determine energy consumption patterns, identify areas of inefficiency, and gauge the potential for energy conservation. This includes creating energy consumption profiles, identifying peak energy usage times, and likening energy consumption data to industry standards.
- **Step 3: Identifying energy conservation opportunities:** this step includes identifying systems or equipment that consume more energy than necessary, identifying areas of energy wastage, and determining opportunities to shift to more energy-efficient methods and equipment.
- **Step 4: Implementation of energy conservation measures:** the next step is to implement energy conservation measures. This includes upgrading equipment, installing energy-efficient lighting, implementing energy-efficient building practices, and executing a comprehensive *energy management program*.
- **Step 5: Monitoring and reporting**: the final step involves monitoring and reporting on energy consumption, energy conservation measures, and their efficacy. This includes creating regular energy consumption reports, conducting energy audits, and monitoring energy consumption over time to identify trends and areas where further conservation measures are needed.
- **Step 6: Continuous improvement**: energy accounting is a continuous process. Therefore, it is essential to regularly repeat it and ensure that the energy conservation measures implemented are still effective and that new opportunities are being identified and acted on.

8. Measuring energy:

Table. 1: **Some conversion factors**

Type of energy	Unit
International system	Joule (J)
Oil	Ton oil equivalent (toe) = 41.8 GJ 1 barrel = 159 L 1 toe = 1165 L = 7.33 b 1 Mtoe/day = 20,000 b/d
Natural gas	1 BCM ($G.m^3$) = 0.9 Mtoe = 1.73 Mt of LNG = 6.29 Mb
Coal	1 ton of coal equivalent (tce) contains 23.3 GJ or 0.55 toe 1 ton of lignite is equivalent to 1/3 of toe
Electricity	1 mega watthour (MWh) = 1000 kWh = 10^6 Wh = 3.6 GJ