Energy Physical Flow accounts

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What is SEEA energy?

SEEA Energy is a ”subsystem” to **SEEA Central Framework**. The SEEA-CF is an international statistical standard for measuring the environment and its relationship with the economy. Three main areas are covered:

1. Environmental flows.
2. Stocks of environmental assets.
3. Economic activity related to the environment.

In the publication **SEEA Energy** you will find agreed concepts, definitions, classifications, tables, and accounts related to energy.

SEEA Energy: main types of information

1) The supply and use of energy (flows)

- Extraction and capture of energy from the environment
- Production, transactions and foreign trade of energy
- Transformation of energy carriers
- Losses of energy during production
- Use of energy products by industries and households

2) The stocks of energy and the changes in them

3) Other economic aspects related to energy

Link statistics to balances to accounts

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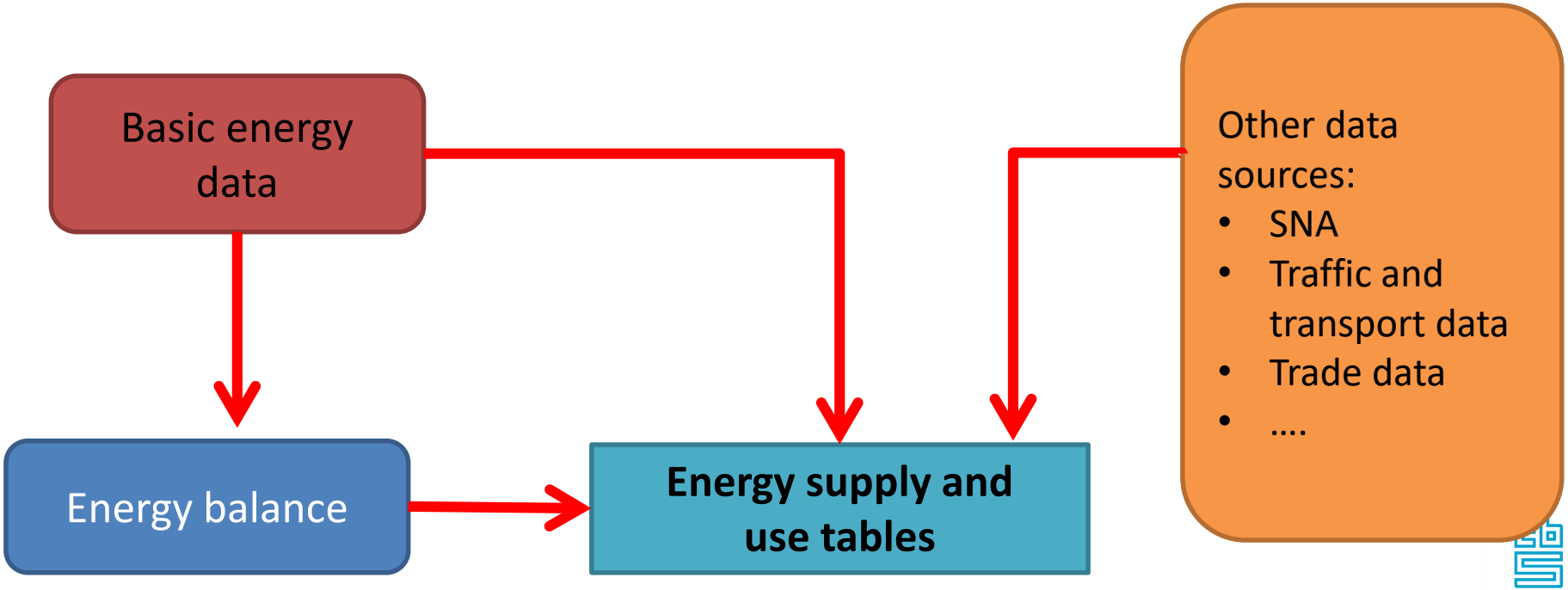


Link statistics to balances to accounts

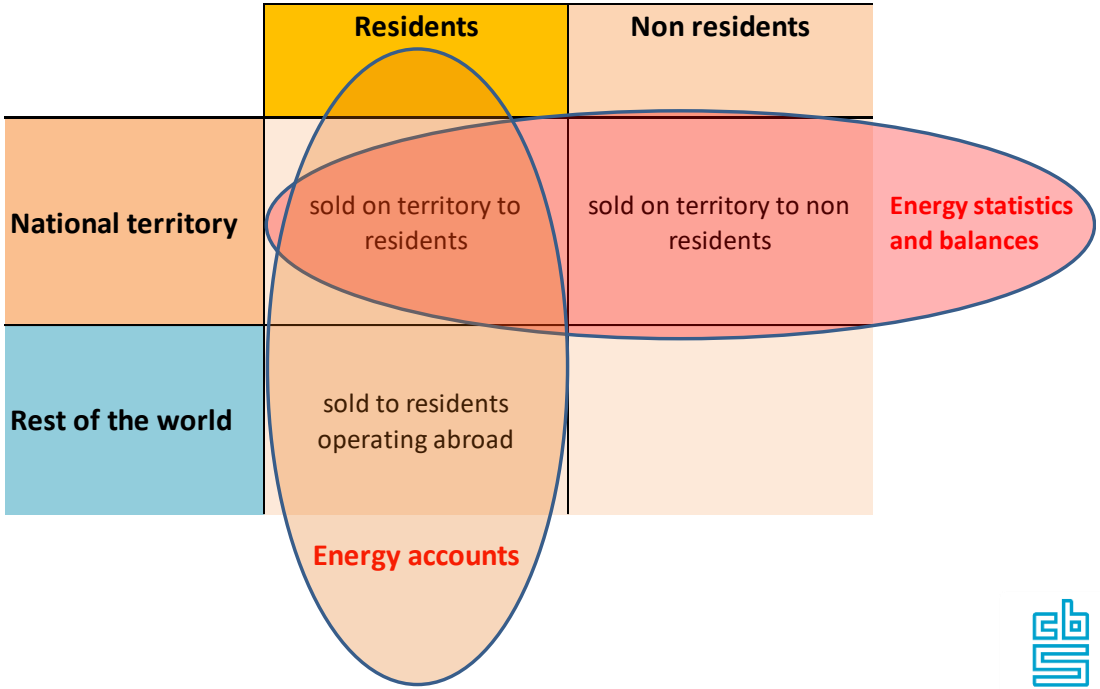
Even though similarities between energy balances and energy accounts, some crucial differences exists:

- Differences in terminology and concepts
- Conceptual differences territory and residence principle
- Treatment of transport

Residence and territory principle

SEEA-Energy uses the residence principle i.e. it records the energy production and energy use of residents regardless of the geographic location.

Energy statistics and **energy balances** use the territory principle instead



Energy as natural inputs, products and residuals

Energy as natural inputs, products and residuals

SEEA-Energy – in accordance with SEEA-CF – distinguishes between three types of ”appearances” of energy:

Natural inputs: These are energy resources as found in the environment, and which can be extracted or captured.

Energy products: This are energy products that are bought and sold or stored in inventories owned by companies. Products are always produced or generated by an economic unit belonging to the national or rest of the world economy.

Energy Residuals: is a term used to describe energy that is discarded, discharged or emitted by industries and households through processes of production, consumption or accumulation.

Energy as *natural inputs*

Energy as natural inputs is in SEEA Energy classified in a way that distinguishes ”conventional” types of natural resources and renewable forms of energy.

Energy natural resource inputs	
Mineral and energy resources	← ”Conventional” solid and liquid natural resources (for extraction)
Oil resources	
Natural gas resources	
Coal and peat resources	
Uranium and other nuclear fuels	
Naural timber resources	
Inputs of energy from renewable sources	← Renewable forms of energy (for capture)
Solar	
Hydro	
Wind	
Wave and tidal	
Geothermal	
Other electicity and heat	
Other natural inputs	← Energy embedded in cultivated biomass (for harvest)
Energy inputs to cultivated biomass	

Energy as *products*

Energy products include electricity, heat, coal, petrol, fuel wood, etc. Some energy products, e.g. oil, may be used for non-energy purposes, for instance to produce plastic.

In the national accounts energy as products is often classified according to the Central Product Classification, CPC.

For the energy accounts, however, it is recommended to use the Standard International Energy Product Classification (SIEC) used in IRES.

There is not always a one-to-one relationship between CPC and SIEC.

SIEC Classification at top level

Classes of energy products
0 Coal
1 Peat and peat products
2 Oil shale / oil sands
3 Natural gas
4 Oil
5 Biofuels
6 Waste
7 Electricity
8 Heat
9 Nuclear fuels and other fuels n.e.c

Energy as *residual*

Energy residuals describe energy that is discarded, discharged or emitted by industries and households through processes of production, consumption or accumulation.

Energy losses are grouped into 5 groups:

- losses during extraction, e.g. when natural gas evaporates during extraction
- losses during distribution, e.g. when an oil tanker spills oil
- losses during storage, e.g. when petrol leaks from a tank
- losses during transformation, e.g. heat losses when coal is used for production of electricity
- Other energy residuals, e.g. fuel for vehicles or electricity for heating

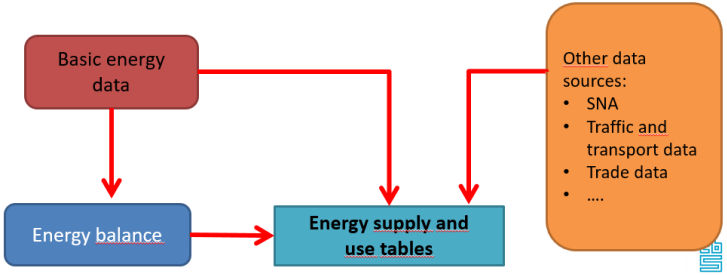
In addition there are some other residual flows related to energy:

- Energy embodied in energy products used for non-energy purposes e.g. plastics
- Energy from solid waste

Supply and use tables energy

In short: Compilation of energy PSUTs

1) Find the right source data
   - Basic energy data
   - Energy balances
   - Additional data



2) Put the data in the accounting format
3) Make corrections for the resident principle (SEEA/SNA concepts)
4) Allocate supply and use to ISIC
5) Make sure supply = use and input = output (accounting identities)
6) Quality assurance

Step 1: From Monetary SUT to Physical SUT

Monetary supply and use table

Supply in €	ISIC 1	ISIC 2	Import	Tax/Sub	Total
Energy product 1	24	1	3	8	**36**
Energy product 2	2	20	18	0	**40**
Products	12	14	16	-25	**17**
Services	15	5	2	-10	**12**
Value added					
Total	**53**	**40**	**39**	**-27**	

Use in €	ISIC 1	ISIC 2	HH	Export	Total
Energy product 1	11	13	10	2	**36**
Energy product 2	3	14	5	18	**40**
Products	4	5	6	2	**17**
Services	3	3	6	0	**12**
Value added	32	5			**37**
Total	**53**	**40**	**27**	**22**	

↓ *Omit non-physical entries and non-energy entries, add physical data*

Supply in PJ	ISIC 1	ISIC 2	Import	Tax/Sub	Total
Energy product 1	125	14	32		**171**
Energy product 2	14	150	138		**302**
Products					
Services					
Value added					
Total	**139**	**164**	**170**		

Use in PJ	ISIC 1	ISIC 2	HH	Export	Total
Energy product 1	55	65	50	10	**180**
Energy product 2	24	112	40	144	**320**
Products					
Services					
Value added					
Total	**79**	**177**	**90**	**154**	

Result: a partial physical supply and use table

Step 2: Extent Physical SUT

Partial physical supply and use table

Supply in PJ	ISIC 1	ISIC 2	Import	Tax/Sub	Total
Energy product 1	125	14	32		**171**
Energy product 2	14	150	138		**302**
Products					
Services					
Value added					
Total	**139**	**164**	**170**		

Use in PJ	ISIC 1	ISIC 2	HH	Export	Total
Energy product 1	55	65	50	10	**180**
Energy product 2	24	112	40	144	**320**
Products					
Services					
Value added					
Total	**79**	**177**	**90**	**154**	

↓ *Add non-monetary physical energy entries*

Supply in PJ	ISIC 1	ISIC 2	HH	Import	Environment	Total
Natural Inputs					100	**100**
Energy product 1	125	14		32		**171**
Energy product 2	14	150		138		**302**
Residuals	40	13	90			**143**
Total	**179**	**177**	**90**	**170**	**100**	**716**

Use in PJ	ISIC 1	ISIC 2	HH	Export	Environment	Total
Natural Inputs	100	0				**100**
Energy product 1	55	65	50	10		**180**
Energy product 2	24	112	40	144		**320**
Residuals					143	**143**
Total	**179**	**177**	**90**	**154**	**143**	**743**

Result: complete physical supply and use table (unbalanced)

Step 3: Balance Physical SUT

Complete physical supply and use table (unbalanced)

Supply in PJ	ISIC 1	ISIC 2	HH	Import	Environment	Total
Natural Inputs					100	**100**
Energy product 1	125	14		32		**171**
Energy product 2	14	150		138		**302**
Residuals	40	13	90			**143**
Total	**179**	**177**	**90**	**170**	**100**	**716**

Use in PJ	ISIC 1	ISIC 2	HH	Export	Environment	Total
Natural Inputs	100	0				**100**
Energy product 1	55	65	50	10		**180**
Energy product 2	24	112	40	144		**320**
Residuals					143	**143**
Total	**179**	**177**	**90**	**154**	**143**	**743**

↓ *Balancing*

Supply in PJ	ISIC 1	ISIC 2	HH	Import	Environment	Total
Natural Inputs					100	**100**
Energy product 1	133	15		32		**180**
Energy product 2	14	160		138		**312**
Residuals	32	2	90			**124**
Total	**179**	**177**	**90**	**170**	**100**	**716**

Use in PJ	ISIC 1	ISIC 2	HH	Export	Environment	Total
Natural Inputs	100	0				**100**
Energy product 1	55	65	50	10		**180**
Energy product 2	24	112	40	136		**312**
Residuals					124	**124**
Total	**179**	**177**	**90**	**146**	**124**	**716**

Result: complete and balanced physical supply and use table

Accounting identities

Supply-Use table is based on two accounting identities (similar to SNA):

1. Supply-use identity (rows):

Total supply = Domestic extraction + Import

is identical to

Total use = Intermediate Consumption + Final Consumption + Gross Capital Formation + Export

2. Input-output identity (columns or industries):

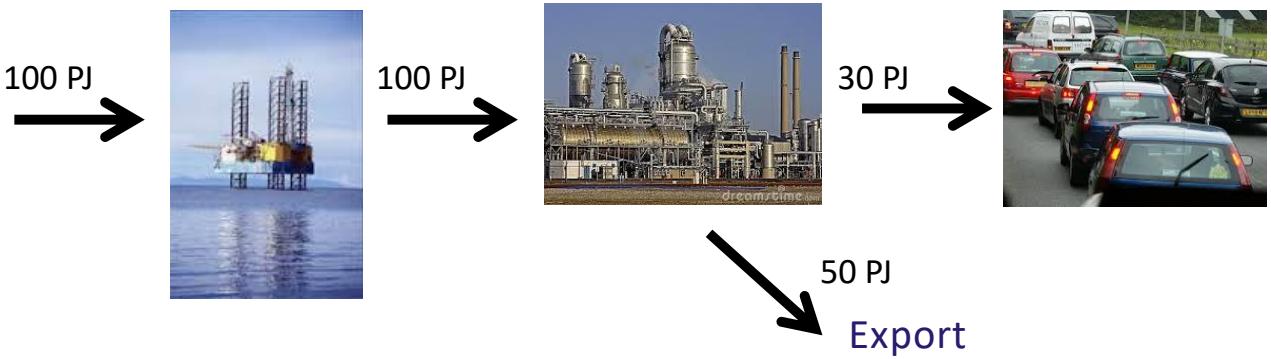
Total inputs industry: product inputs + resource inputs

is identical to

Total outputs industry = product outputs + residual outputs + net additions to stock

Example

- Mining of oil resources by mining industry (100 PJ)
- Supply of crude oil to refinery (100 PJ)
- Refining of crude oil -> production of petrol (80 PJ)
- Export of petrol (50 PJ)
- Use of petrol by Households (30 PJ)



Mining of oil resources

100 PJ →

SUPPLY		Mining ISIC 6	Refinery ISIC 19	Households	Imports	Environment	TOTAL
Natural inputs	Oil resources					100	100
	Crude oil						0
Products	Petrol						0
Residuals	Transformation losses						0
	Heat losses						0
Total		0	0	0	0	100	100

USE		Mining ISIC 6	Refinery ISIC 19	Households	Exports	Environment	TOTAL
Natural inputs	Oil resources	100					100
	Crude oil						100
Products	Petrol						0
Residuals	Transformation losses						0
	Heat losses						0
Total		100	0	0	0	0	100

Supply to refineries

100 PJ →

SUPPLY		Mining ISIC 6	Refinery ISIC 19	Households	Imports	Environment	TOTAL
Natural inputs	Oil resources					100	100
	Crude oil	100					100
Products	Petrol						0
Residuals	Transformation losses						0
	Heat losses						0
Total		100	0	0	0	100	200

USE		Mining ISIC 6	Refinery ISIC 19	Households	Exports	Environment	TOTAL
Natural inputs	Oil resources	100					100
	Crude oil		100				100
Products	Petrol						0
Residuals	Transformation losses						0
	Heat losses						0
Total		100	100	0	0	0	200

Production and use of petrol

30 J →

50 J → **export**

SUPPLY		Mining ISIC 6	Refinery ISIC 19	Households	Imports	Environment	TOTAL
Natural inputs	Oil resources					100	100
	Crude oil	100					100
Products	Petrol		80				80
Residuals	Transformation losses		20				20
	Heat losses						0
Total		100	100	0	0	100	300

USE		Mining ISIC 6	Refinery ISIC 19	Households	Exports	Environment	TOTAL
Natural inputs	Oil resources	100					100
	Crude oil		100				100
Products	Petrol			30	50		80
Residuals	Transformation losses						0
	Heat losses						0
Total		100	100	30	50	0	280

Recording of residuals

SUPPLY		Mining ISIC 6	Refinery ISIC 19	Households	Imports	Environment	TOTAL
Natural inputs	Oil resources					100	100
	Crude oil	100					100
Products	Petrol		80				80
Residuals	Transformation losses		20	30			50
	Heat losses						0
Total		100	100	30	0	100	330

USE		Mining ISIC 6	Refinery ISIC 19	Households	Exports	Environment	TOTAL
Natural inputs	Oil resources	100					100
	Crude oil		100				100
Products	Petrol			30	50		80
Residuals	Transformation losses					50	50
	Heat losses						0
Total		100	100	30	50	50	330

Ways of recording

Total supply and use include double counting. Therefore:

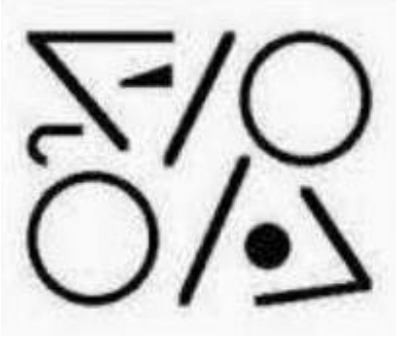
Other energy tables that can be derived from SUTs:

- Supply primary inflow (primary products and import)
- Transformation for end use
- End use of energy

What is the purpose and advantages of accounting ?

Statistics:

- Are closer to source data
- Provide more detail
- Easier to compile?



Accounts:

- Consistent (in time, with respect to concepts, methods, definitions and classifications)
- Coherent (between accounts and SNA, data confrontation, more opportunity for analyses and policy applications)
- Comprehensive (cover the whole economy)

What can you do with the energy accounts?

Energy use by sector linked to value added, employment, taxes and subsidies.

Resource productivity (and efficiency): value added per unit energy use per sector.

Decoupling: economic growth or emissions to air in relation to energy use

Footprint calculations (consumption perspective): addition to monetary IO tables for IO analyses.

Decomposition analyses: drivers behind changes in time (economic growth, energy mix, efficiency)

Thank you. Questions?