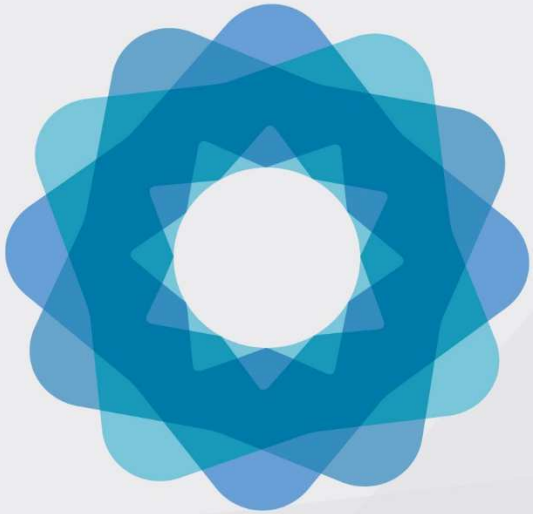


# System of Environmental Economic Accounting

System of Environmental Economic Accounting

# Monetary asset accounts for energy

United Nations

# Overview

- Scope and classifications
- The monetary asset account
- Valuation of energy assets and changes in them
- Monetary asset accounts for inventories of energy products
- Uses of the accounts
- Implementation
- Data sources
- Where do you find more information?

# Monetary asset accounts for energy

Monetary asset accounts for energy resources provide a ***market based valuation*** of the physical stocks of mineral and energy resources and the changes in the value of these stocks over time

In practice this means that the starting point is the physical asset accounts and that the task is to **associate the physical quantities with corresponding market values**

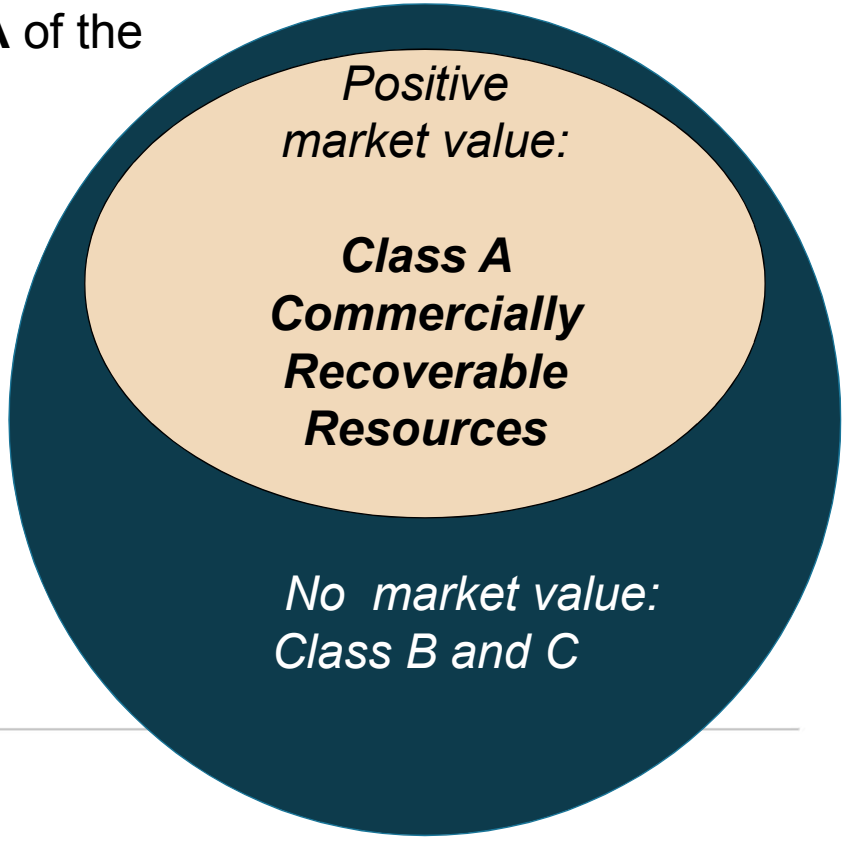
# Focus on Class A *Commercially Recoverable Resources*

We can assume that quantities of mineral and energy resources have an associated positive market value if there is an expectation that the resources will be extracted and sold with a profit at some point in the future.

**Therefore:** In practice we can look at **Class A** of the SEEA Energy resource classification:

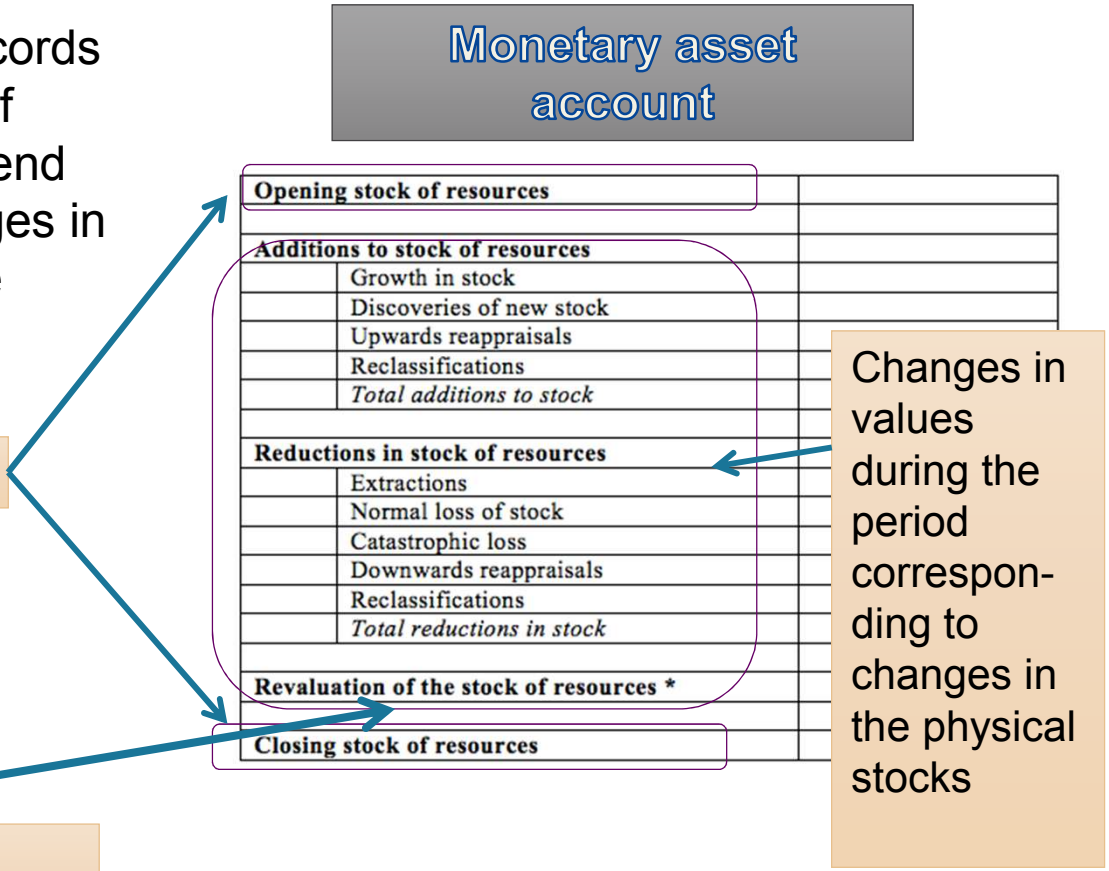
***Class A Commercially Recoverable Resources:***
Extraction is currently taking place or is underway or for which the feasibility of extraction has been demonstrated.

Further, the extraction of the resources in this class is expected to be economically viable on the basis of current market conditions and realistic assumptions for future market conditions.



# The monetary asset account for energy resources

The monetary asset accounts records ***the market value*** of the stocks of energy at the beginning and the end of a period and all types of changes in the value of the stocks during the period.



# Correspondence between physical and monetary asset accounts

All items in the monetary asset account corresponds to similar items in the physical asset accounts *except one*

The extra item in the monetary asset accounts is ***Revaluation of the stock of resources***

It reflects the effect on value of the stock of price changes, i.e. when the price goes up the stock value increase and when the price goes down the stock value decrease

**Monetary asset account**

| | |
|---|---|
| **Opening stock of resources** | |
| | |
| **Additions to stock of resources** | |
| Growth in stock | |
| Discoveries of new stock | |
| Upwards reappraisals | |
| Reclassifications | |
| *Total additions to stock* | |
| | |
| **Reductions in stock of resources** | |
| Extractions | |
| Normal loss of stock | |
| Catastrophic loss | |
| Downwards reappraisals | |
| Reclassifications | |
| *Total reductions in stock* | |
| | |
| **Revaluation of the stock of resources *** | |
| | |
| **Closing stock of resources** | |

Revaluation item reflecting the pure effect of price changes

# The identity of the monetary asset accounts

The monetary asset account "explains" the development of the value of the resource from the beginning to the end of the period. The "explanation" is given by the basic identity that the **closing stock is always equal to the opening stock plus changes in the value during the period.**

Identity of the asset accounts:

Opening stock
\+ Additions to stocks
\- Reductions in stocks
\+ Revaluation of the stock
= Closing stock

**Monetary asset account for natural gas**

| | | Million Currency units |
|---|---|---|
| Opening stock | | 12 000 |
| *+ Additions to stock* | | |
| Upward reappraisals | + | 2 000 |
| *- Reductions in stocks* | | |
| Extractions of natural gas | - | 500 |
| + Revaluation of the stock | + | 400 |
| = Closing stock | = | 13 900 |

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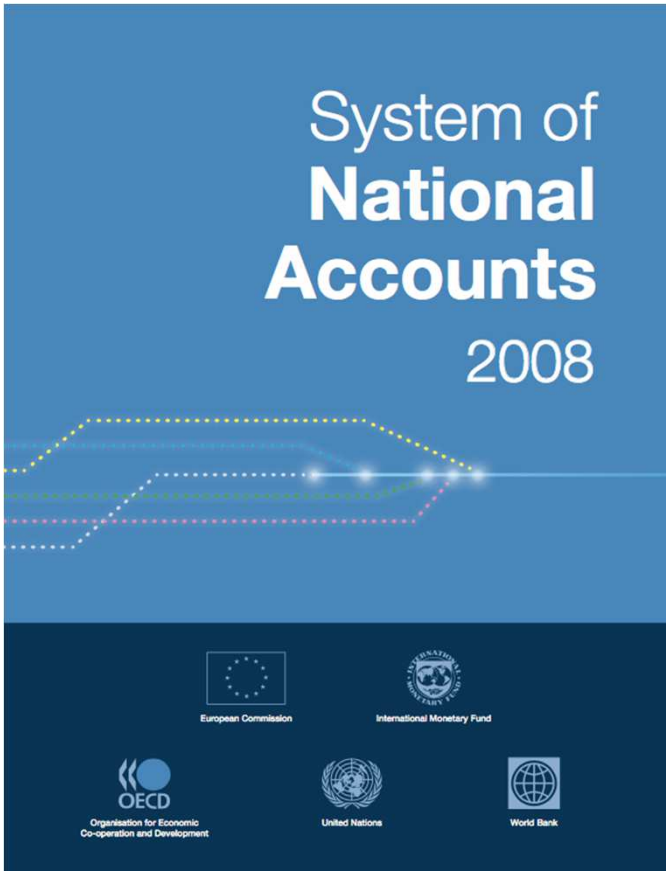
# The link to the 2008 SNA

In the system of national accounts, SNA 2008, energy assets are also included as *Mineral and energy reserves (AN212)* under the heading *non-produced non-financial assets*

The terms and the descriptions are somewhat different in SEEA Energy and the SNA 2008 but the scope and principles are the same.

In practice the precise SEEA Energy guidelines for monetary energy asset accounts can be used also for the national accounts



# Valuation of the stock of energy resources

If the energy resources in the ground (i.e. before extraction) are bought and sold in the market, the observable **market values** should be used for the valuation of the resource.

However, although prices of the output from extraction of an energy resource can be found, often no market transactions of the resource itself take place, and **as a rule market values of the energy resources can not be observed**.

In such cases, **proxies for the market values has to be estimated based on economic theory and assumptions.**

# The net present value method, NPV

Various methods for estimation of proxies for market values of energy resources exist, but the recommended method is the so-called ***net present value method***

The method is based on the ***assumption that the market value is equal to the sum of expected future earnings from the use of the ressource***

**Future earnings are assumed to be of less value here and now** than earnings accruing presently

Future earnings therefore have to be multiplied by a ***discount factor*** to estimate the present value of the future earnings.

# Rationale of discounting future currency amounts

If you have to choose between getting 100 $ now or somewhere in the future, you would normally prefer to get it now

In other words: An earning of 100 $ in the future is regarded as being worth less than 100 $ in the present period.

Example: Estimating the present value of 100 $ with a discount rate of 2 per cent per year

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Actual sum in year, $ | 100 | 100 | 100 | 100 | 100 |
| Present (2016) value, $ | 100 | 98 | 96 | 94 | 92 |

Discounting by 2 per cent means that the present value of 100 $ decreases by 2 percent each year it moves further out in the fut

# Five steps in estimating the net present value of a resource stock

1) The **future extraction profile** in physical terms is established

2) Expected future earnings, called **resource rent**, per unit extracted resource is calculated.

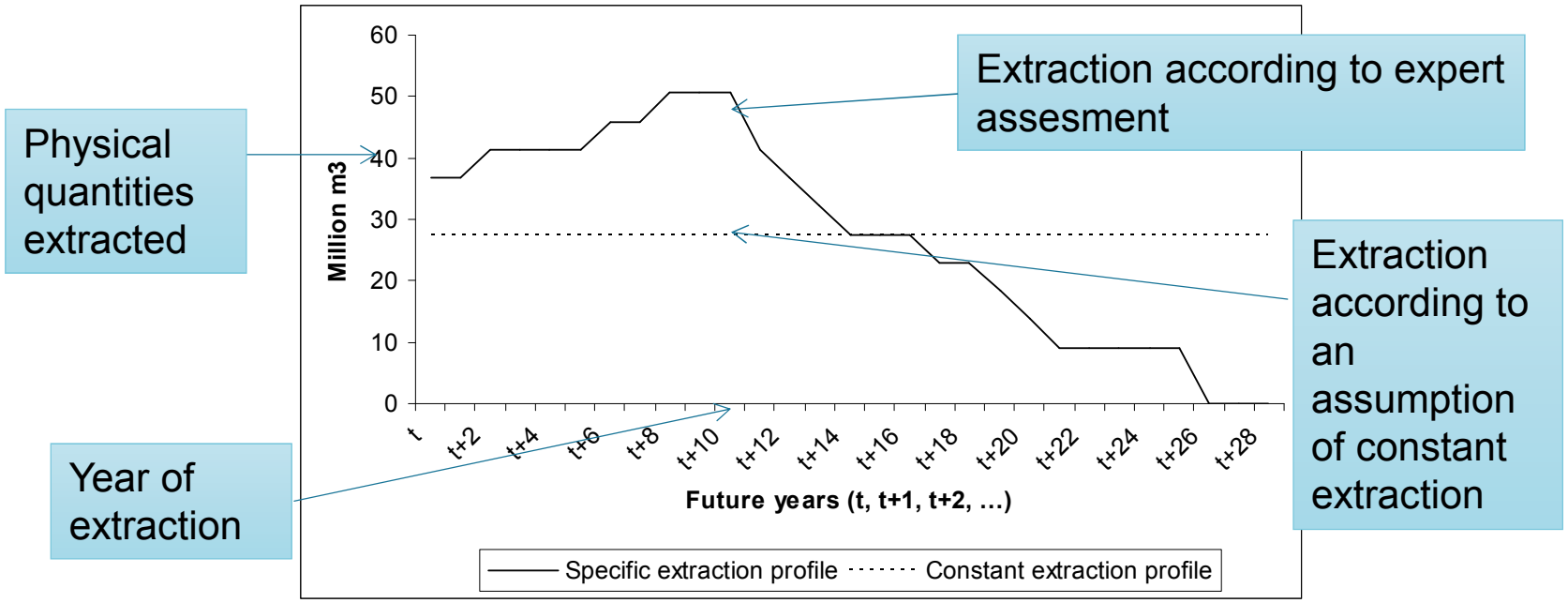
3) For each future period **the total expected future earnings** (total resource rent) is estimated by multiplying the physical extraction by the unit resource rent

4) For each future period the **net present value of the total resource rent** is estimated by discounting to present period value

5) **Total net present value** is calculated by adding up all future resource rents discounted to present period value.

# Step 1) Establishing the future extraction profile

For each of **the future years the extraction** is determined based on expert asessment, if available. If no specific expert knowledge exist you may assume a constant extraction profile, i.e. a constant extraction until the resource have been totally exhausted.



# Step 2) Estimation of the resource rent for the present period

The resource rent is a measure of the net surplus generated by extraction of the resource after all costs of the extraction have been deducted. The resource rent can be seen as the price of the commercial mineral and energy resources in ground.

Using national accounts terminology the resource rent can be estimated by deducting capital costs and adding taxes less subsidies specific for the extraction industry to the gross operating surplus

When the total resource rent of the year is divided by the physical quantity extracted a *per unit resource rent* is obtained.

| | Extraction of energy resources currency units |
|---|---|
| Output | **60 744** |
| Operating costs | 7 289 |
| Intermediate consumption | 6 487 |
| Compensation of employees | 802 |
| Other taxes and subsidies on production | 17 |
| Gross Operating Surplus | **53 455** |
| Specific taxes and subsidies | - 100 |
| Consumption of fixed capital | 5 084 |
| Return to produced assets | 5 519 |
| **Resource rent** | **42 952** |
| Quantities of resource extacted, million $m^3$ | 20 |
| **Per unit resource rent** (currency units per million $m^3$) | **2 148** |

Value of extraction

- Current costs of extraction

+ Specific taxes and subsidies

- Fixed capital costs

=Total resource rent

Per unit resource rent = 2 148

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# Step 3) Estimation of all the expected future unit resource rents

For each future period the total expected future earnings (total resource rent) is estimated by multiplying the physical extraction by the unit resource rent

The unit resource rent in the first year is here assumed to be equal to the present resource rent (step 2) with an annual increase of 3 per cent each year due to inflation.

Other assumptions could be used

| Year of extrac-tion | Physical extraction Million $m^3$ | Unit resource rent, current prices | Resource rent, current prices |
|---|---|---|---|
| t | 37 | 2 148 | 79 476 |
| t+1 | 37 | 2 212 | 81 860 |
| t+2 | 41 | 2 279 | 93 431 |
| t+3 | 41 | 2 347 | 96 234 |
| t+4 | 41 | 2 418 | 99 121 |
| t+5 | 41 | 2 490 | 102 095 |
| t+6 | 46 | 2 565 | 117 982 |
| ... | ... | ... | ... |

Total resource rent is equal to the physical extraction multiplied by the per unit resource rent

Specific extraction profile for the physical extraction

# Step 4) Discounting the future resource

Each resource rent is discounted by a **discount rate**.

If the undiscounted resource rent is at current prices (including the effect of inflation, the discount factor has to take account of the inflation (i.e. higher discount rate)

Discount factor (6 percent)

$= 1/(1+0.06)^t$

| Year of extraction | Physical extraction Million $m^3$ | Unit resource rent, current prices | Resource rent, current prices | Discount factor (6 percent) | Discounted resource rents |
|---|---|---|---|---|---|
| t | 37 | 2 148 | 79 476 | 0,94 | 74 977 |
| t+1 | 37 | 2 212 | 81 860 | 0,89 | 72 855 |
| t+2 | 41 | 2 279 | 93 431 | 0,84 | 78 447 |
| t+3 | 41 | 2 347 | 96 234 | 0,79 | 76 227 |
| t+4 | 41 | 2 418 | 99 121 | 0,75 | 74 069 |
| t+5 | 41 | 2 490 | 102 095 | 0,70 | 71 973 |
| … | … | … | … | … | … |

Discounted resource rents = Resource rents multiplied by the discount factor

# Step 5) Estimating total future discounted ressource rents

Finally, discounted resource rents are added up to give the present value of all future extractions.
This is assumed to be **the market value of the resource**

All discounted values of resource rents

| Year of extrac-tion | Physical extraction Million $m^3$ | Unit resource rent, current prices | Resource rent, current prices | Discount factor (6 percent) | Discounted resource rents |
|---|---|---|---|---|---|
| t | 37 | 2 148 | 79 476 | 0,94 | 74 977 |
| t+1 | 37 | 2 212 | 81 860 | 0,89 | 72 855 |
| t+2 | 41 | 2 279 | 93 431 | 0,84 | 78 447 |
| t+3 | 41 | 2 347 | 96 234 | 0,79 | 76 227 |
| t+4 | 41 | 2 418 | 99 121 | 0,75 | 74 069 |
| t+5 | 41 | 2 490 | 102 095 | 0,70 | 71 973 |
| t+6 | 46 | 2 565 | 117 982 | 0,67 | 78 465 |
| t+7 | 46 | 2 642 | 121 521 | 0,63 | 76 244 |
| t+8 | 51 | 2 721 | 138 772 | 0,59 | 82 139 |
| t+9 | 51 | 2 803 | 142 935 | 0,56 | 79 814 |
| t+10 | 51 | 2 887 | 147 223 | 0,53 | 77 555 |
| t+11 | 41 | 2 973 | 121 907 | 0,50 | 60 584 |
| t+12 | 37 | 3 063 | 113 314 | 0,47 | 53 126 |
| t+13 | 32 | 3 154 | 100 941 | 0,44 | 44 646 |
| t+14 | 28 | 3 249 | 90 973 | 0,42 | 37 960 |
| t+15 | 28 | 3 347 | 93 702 | 0,39 | 36 886 |
| t+16 | 28 | 3 447 | 96 513 | 0,37 | 35 842 |
| t+17 | 23 | 3 550 | 81 657 | 0,35 | 28 608 |
| t+18 | 23 | 3 657 | 84 107 | 0,33 | 27 798 |
| t+19 | 18 | 3 767 | 67 798 | 0,31 | 21 140 |
| t+20 | 14 | 3 880 | 54 313 | 0,29 | 15 977 |
| t+21 | 9 | 3 996 | 35 963 | 0,28 | 9 980 |
| t+22 | 9 | 4 116 | 37 042 | 0,26 | 9 698 |
| t+23 | 9 | 4 239 | 38 153 | 0,25 | 9 423 |
| t+24 | 9 | 4 366 | 39 298 | 0,23 | 9 156 |
| t+25 | 9 | 4 497 | 40 477 | 0,22 | 8 897 |
| **Total** | **593** | | 1 556 814 | | **1 001 122** |

Total extraction of the resource
= total stock of resources included in the valuation

Total present value of the extractions
= **Value of the resource at the beginning of period t**

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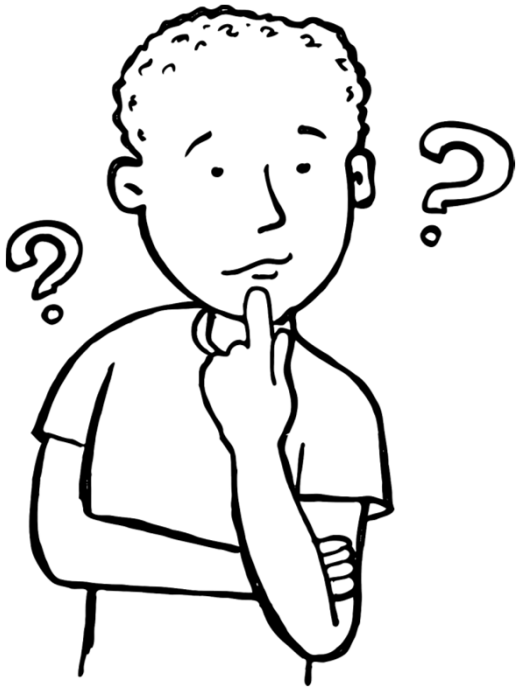
# Uncertainties in the NPV valuation method

The NPV method is based on many assumptions and non-observable factors. Thus, the uncertainties are big.

- The uncertainties relate especially to:
- **The extraction profile**: A difefrent profile for the same stock will give another present value
- The resource rents depends on **assumptions of prices and costs** of future extractions
- **The discount factor**: A higher discount factor gives a smaller present value



# Analysis based on the monetary asset accounts

The monetary asset accounts for energy resources present an economic assessment of the resources and changes in them.

This can be used for  to the measurement ***of a country's total wealth*** including not only human-made capital such as buildings, machinery and transport equipment but also the natural resources of the country.

It helps assess **whether current patterns of economic activity are depleting the energy resources** and what the **potential future streams of income** for government and other may be.

# Implementation: building on the physical asset accounts

The first step in building monetary asset accounts is **to build on the physical asset accounts.**

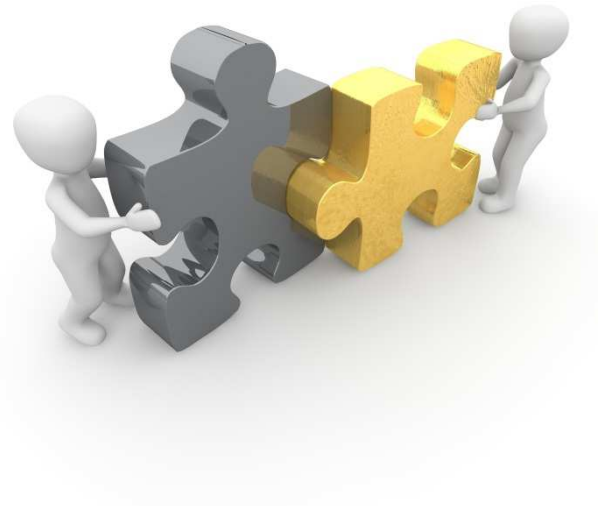
Next step is to **do the valuation of the opening and closing stocks**, either by obtaining market prices, or – for the energy resources - more often using the Net Present Value, NPV, method.

Once the stock values are in place **average resource prices** can be estimated and then the **values of the various changes** in the resource stocks and finally the **revaluation** due to price changes

# Data sources

Information on output and costs of the mining/extraction industry from the national accounts, if available - otherwise from company accounts and reports, etc.

Assessments of physical extraction profiles from Energy Agencies or other energy resource experts etc.



# Summary of the module

- The scope of the monetary asset accounts is only those energy resources, which have a market value. In practice it is **Class A Commercially Recoverable Resources**
- All items in the monetary asset account **corresponds to similar items in the ph*ysical asset accounts except one for revaluation*** *of the stock of resources*
- As a rule market values of the energy resources can not be observed. Therefore **the Net Present Value, NPV, Method is used to value the resource stock and derive prices for the energy resource**
- The **NPV method relies on assumptions** on future extractions, resource rents and a discount rate
- There is quite much **uncertainty** involved, and presentation of sensitivity analysis is recommended
- Monetary **asset accounts for inventories of energy products** can also be constructed.
- The monetary asset accounts can be used to assess **national wealth, future earnings, and the economic costs of the depletion** of energy resources
- The value of depletion can be used for estimation of so-called **depletion adjusted economic aggregates**

# Where do you find more information?

Chapter 6 in SEEA Energy describes in more detail what has been presented in this module
http://unstats.un.org/unsd/envaccounting/seeae/

Chapter 5 in SEEA Central Framework presents the general features of monetary asset accounts and the use of the NPV method
http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf

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