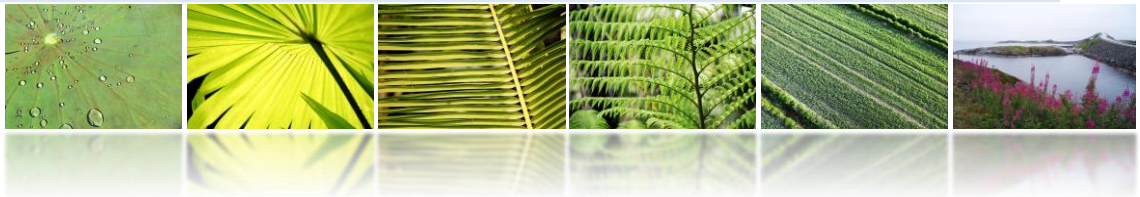
United Nations
Statistics Division

Natural Gas - Exercise



Leonardo Souza
Chief, Energy Statistics Section

Lima, Peru, 12 November 2019
Workshop on energy statistics for the LA and the C regions

Natural Gas

- 68000 MMcf of natural gas were extracted in a given year, being 20500 MMcf non-associated gas, and 47500 MMcf associated gas
- Of these, 30000 MMcf were not used, of which:
  - 20000 MMcf reinjected, 8000 MMcf flared, and 2000 MMcf vented.
- 1000 MMcf were used for energy purposes in the oil and gas fields to support operations.
- 10000 MMcf entered gas plants to produce 400 kt of LPG.
- 15000 MMcf were exported as LNG, and an additional 1000 MMcf were used to compress natural gas into LNG
- The balance of withdrawals and deposits to main storage units amounted to an decrease of 1000 MMcf in storage

- 9000 MMcf were used to generate electricity, being:
  - 5000 MMcf by main activity producers to generate 485 GWh, being 4900 MMcf as input to transformation and 100 MMcf to support the power plant operation.
  - 4000 MMcf by autoproducers in the non-energy mining sector to generate 370 GWh (80 MMcf to support the power plant operation)
- The remainder 2000 MMcf were consumed by final consumer, being:
  - 800 MMcf by the industry (of which 200 MMcf as feedstock to produce fertilizers), 500 MMcf by households, and 700 MMcf by commercial enterprises

Exercises

- How to account for this info in energy statistics?
- Calculate production, supply, transformation, own use, final energy consumption and non-energy use.
- How to fill the energy balance with this info?
- Note: By default, 1 MMcf is roughly equivalent to 0.891 TJ, because:
  - Default calorific value of natural gas: 47.3 TJ/MM m^3
  - 1 cubic foot = 0.02283168 m^3

Reference: concept of production

- 5.10: Primary production is the capture or extraction of fuels or energy… within the national territory in a form suitable for use. Inert matter removed from the extracted fuels and quantities reinjected, flared or vented are not included.

Data for oil and gas production should be NET of reinjected, flared and vented quantities (and water, sand etc.)

Reference: definition of natural gas (SIEC)

- 3 - Natural gas: A mixture of gaseous hydrocarbons, primarily methane, but generally also including ethane, propane and higher hydrocarbons in much smaller amounts and some non-combustible gases such as nitrogen and carbon dioxide.

- *Remark*: The majority of natural gas is separated from both non-associated gas originating from fields producing hydrocarbons only in gaseous form, and associated gas produced in association with crude oil. The separation process produces natural gas by removing or reducing the hydrocarbons other than methane to levels that are acceptable in the marketable gas. The natural gas liquids (NGL) removed in the process are distributed separately. (…)

- Natural gas may be liquefied (LNG) by reducing its temperature in order to simplify storage and transportation when production sites are remote from centers of consumption and pipeline transportation is not economically practicable.

Reference: transformation and own use

5.18 *Transformation* is the process where part or all of the energy content of a product entering the process moves to one or more different products leaving the process.

Ex: coal → electricity; crude oil → oil products; fuelwood → charcoal

5.20 *Energy industries own use* refers to the consumption of fuels and energy for the direct support of the production and preparation for use of fuels and energy, except heat not sold.

Ex: energy used for heating a blast furnace; or electricity used for feeding the auxiliaries of a power plant

Production

This

PRODUCTION

- 68000 MMcf of natural gas were extracted in a given year, being 20500 MMcf non-associated gas, and 47500 MMcf associated gas

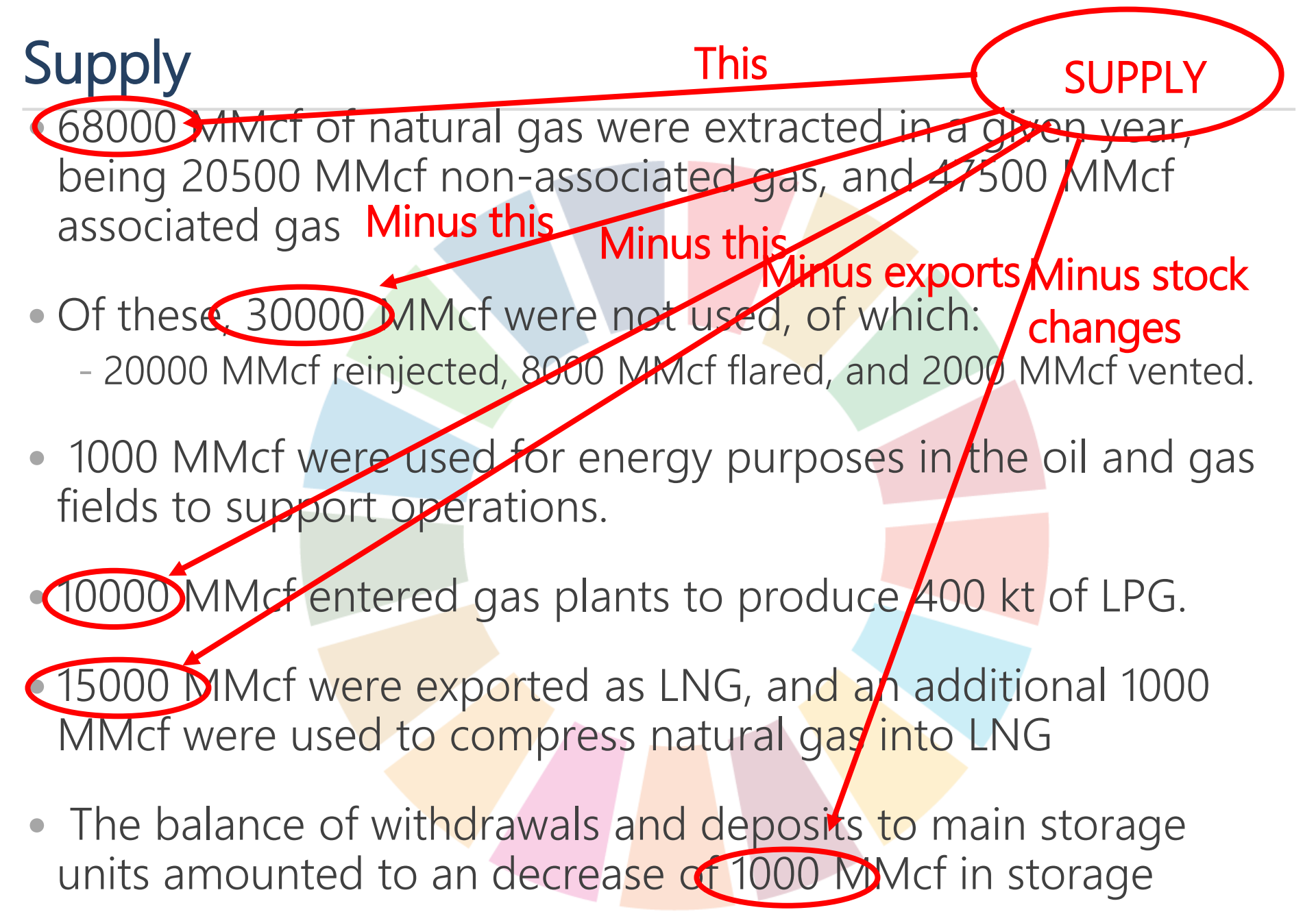
Minus this

Minus this

- Of these, 30000 MMcf were not used, of which:
  - 20000 MMcf reinjected, 8000 MMcf flared, and 2000 MMcf vented.
- 1000 MMcf were used for energy purposes in the oil and gas fields to support operations.
- 10000 MMcf entered gas plants to produce 400 kt of LPG.
- 15000 MMcf were exported as LNG, and an additional 1000 MMcf were used to compress natural gas into LNG
- The balance of withdrawals and deposits to main storage units amounted to an decrease of 1000 MMcf in storage

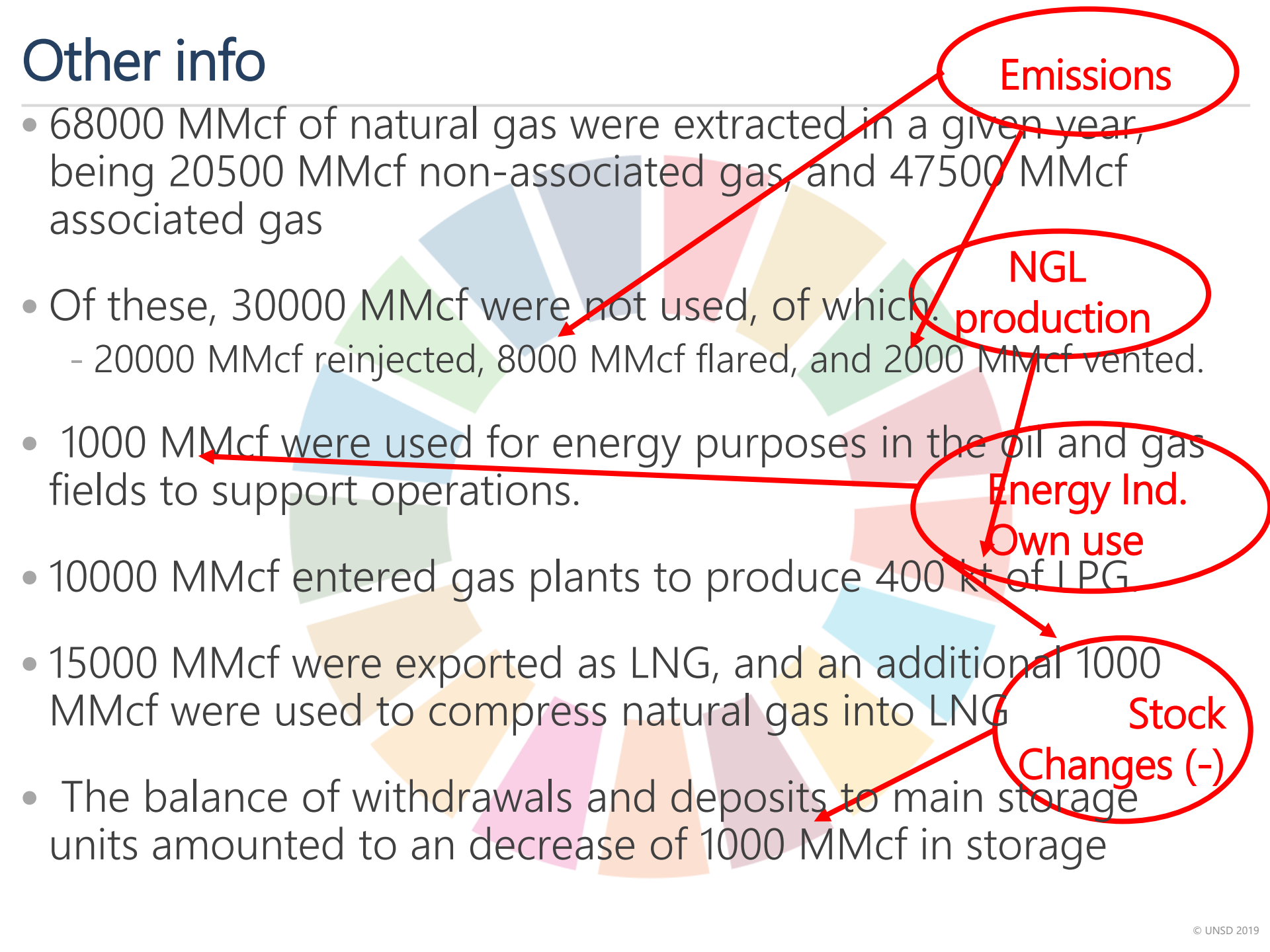
Supply

- 68000 MMcf of natural gas were extracted in a given year, being 20500 MMcf non-associated gas, and 47500 MMcf associated gas
- Of these, 30000 MMcf were not used, of which:
  - 20000 MMcf reinjected, 8000 MMcf flared, and 2000 MMcf vented.
- 1000 MMcf were used for energy purposes in the oil and gas fields to support operations.
- 10000 MMcf entered gas plants to produce 400 kt of LPG.
- 15000 MMcf were exported as LNG, and an additional 1000 MMcf were used to compress natural gas into LNG
- The balance of withdrawals and deposits to main storage units amounted to an decrease of 1000 MMcf in storage



Other info

- 68000 MMcf of natural gas were extracted in a given year, being 20500 MMcf non-associated gas, and 47500 MMcf associated gas
- Of these, 30000 MMcf were not used, of which:
  - 20000 MMcf reinjected, 8000 MMcf flared, and 2000 MMcf vented.
- 1000 MMcf were used for energy purposes in the oil and gas fields to support operations.
- 10000 MMcf entered gas plants to produce 400 kt of LPG
- 15000 MMcf were exported as LNG, and an additional 1000 MMcf were used to compress natural gas into LNG
- The balance of withdrawals and deposits to main storage units amounted to an decrease of 1000 MMcf in storage



Transf., own use, final consumption

- 9000 MMcf were used to generate electricity, being:
  - 5000 MMcf by main activity producers to generate 485 GWh, being 4900 MMcf as input to transformation and 100 MMcf to support the power plant operation.
  - 4000 MMcf by autoproducers in the non-energy mining sector to generate 370 GWh (80 MMcf to support the power plant operation)
- The remainder 2000 MMcf were consumed by final consumer, being:
  - 800 MMcf by the industry (of which 200 MMcf as feedstock to produce fertilizers), 500 MMcf by households, and 700 MMcf by commercial enterprises

Transformation

minus

Own use

Final energy consumption

Excluding non-energy use

Answers - production, supply, transformation

- Production
  - 68000 MMcf – 30000 MMcf – 10000 MMcf = 28000 MMcf
  - 28000 MMcf x 0.981 TJ/MMcf = 27468 TJ
- Supply
  - In this case, **Supply** = **Production** minus **exports** minus **stock changes** = 28000 – 15000 – (-1000) = 14000 MMcf
  - 14000 MMcf x 0.981 TJ/MMcf = 13724 TJ
- Transformation (main activity PP + autoproducers)
  - 4900 + [4000 – 80] = 8820 TJ
  - 8820 MMcf x 0.981 TJ/MMcf = 8652.4 TJ

own use, final energy consumption and non-energy use

- Own use (liquefaction plants + oil and gas fields + electricity plants)
  - 1000 MMcf + 1000 MMcf + 100 MMcf + 80 MMcf = 2180 MMcf = 2138.6 TJ
- Final energy consumption (industry, commerce & households)
  - [800 – 200] MMcf + 700 MMcf + 500 MMcf = 1800 MMcf
  - 1800 MMcf x 0.981 TJ/MMcf = 1765.8 TJ
- Non-energy use (feedsstock to produce fertilizers)
  - 200 MMcf = 196.2 TJ