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Land use and land use change modelling

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Agroscope

Land occupation and transformation

- Land occupation: duration of crop cycle (including fallow period and catch crops) x area required to produce a unit of product (1/yield)
- Land transformation: all agricultural dataset inventories need to have land transformation
- Land transformation *from* and land transformation *to* must be of equal size

Direct and indirect land use change

- Direct land use change: history of the piece of land occupied by the considered crop
- Indirect land use change: impacts on other areas than the occupied area

Update LUC inventories

- Goal: update of the emission from direct LUC for all relevant crop activities:
  - Soybean, Brazil (BR)
  - Sugarcane, BR
  - Palm fruit bunches, Malaysia (MY)

- Consistent consideration of all carbon pools (IPCC 2006)
  - Above Ground Biomass (AGB)
  - Below Ground Biomass (BGB)
  - Dead Organic Matter (DOM)
  - Soil Organic Carbon (SOC)

Conditions for inclusion of LUC

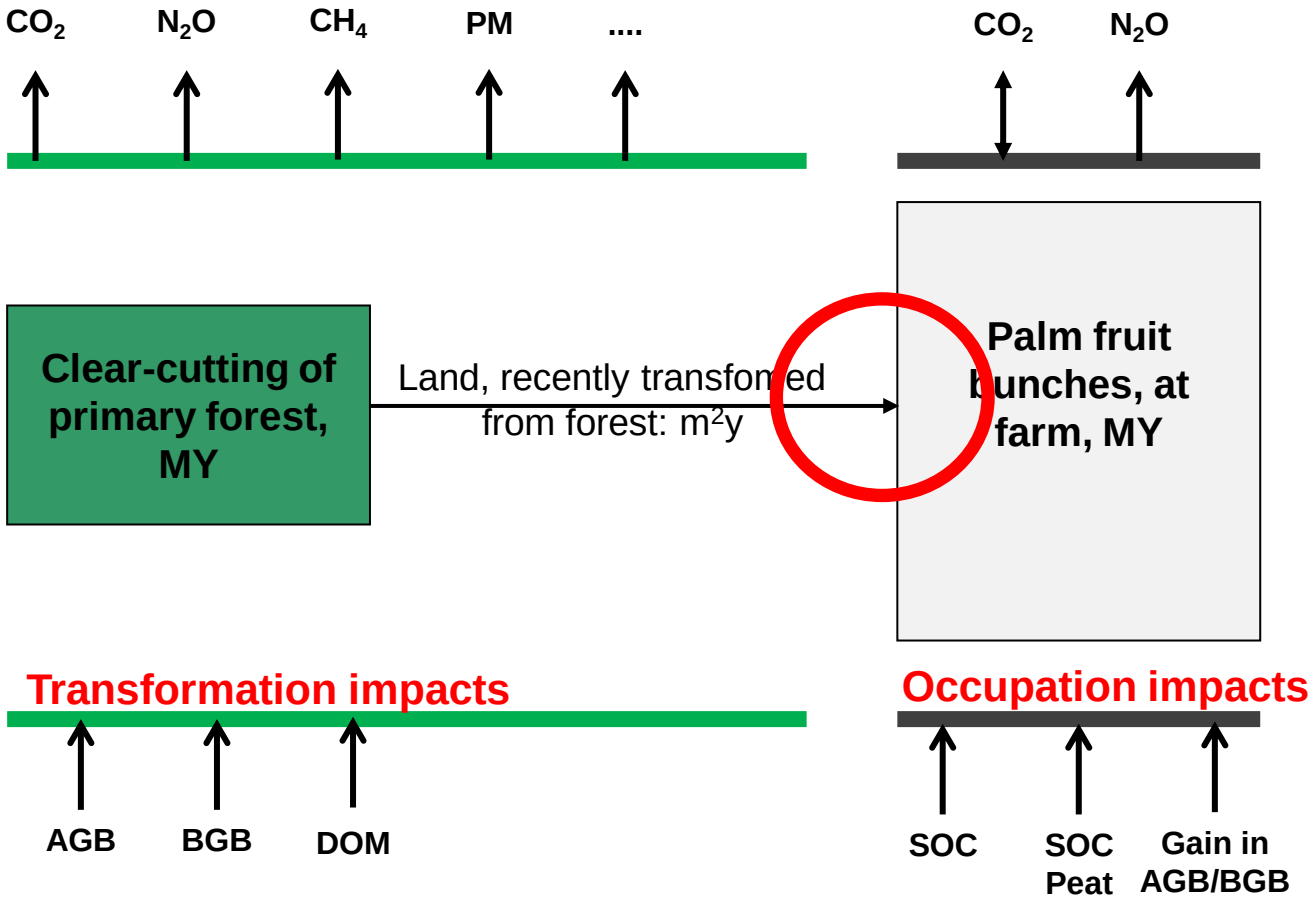
- LUC was considered, if

1. the **crop area** in the country and
2. its **corresponding total land type area has increased** in the last 20 years, and
3. If the **natural ecosystem decreased** during the same time period

Direct LUC was considered to be potentially relevant only if all three conditions were met by an analysed crop activity.

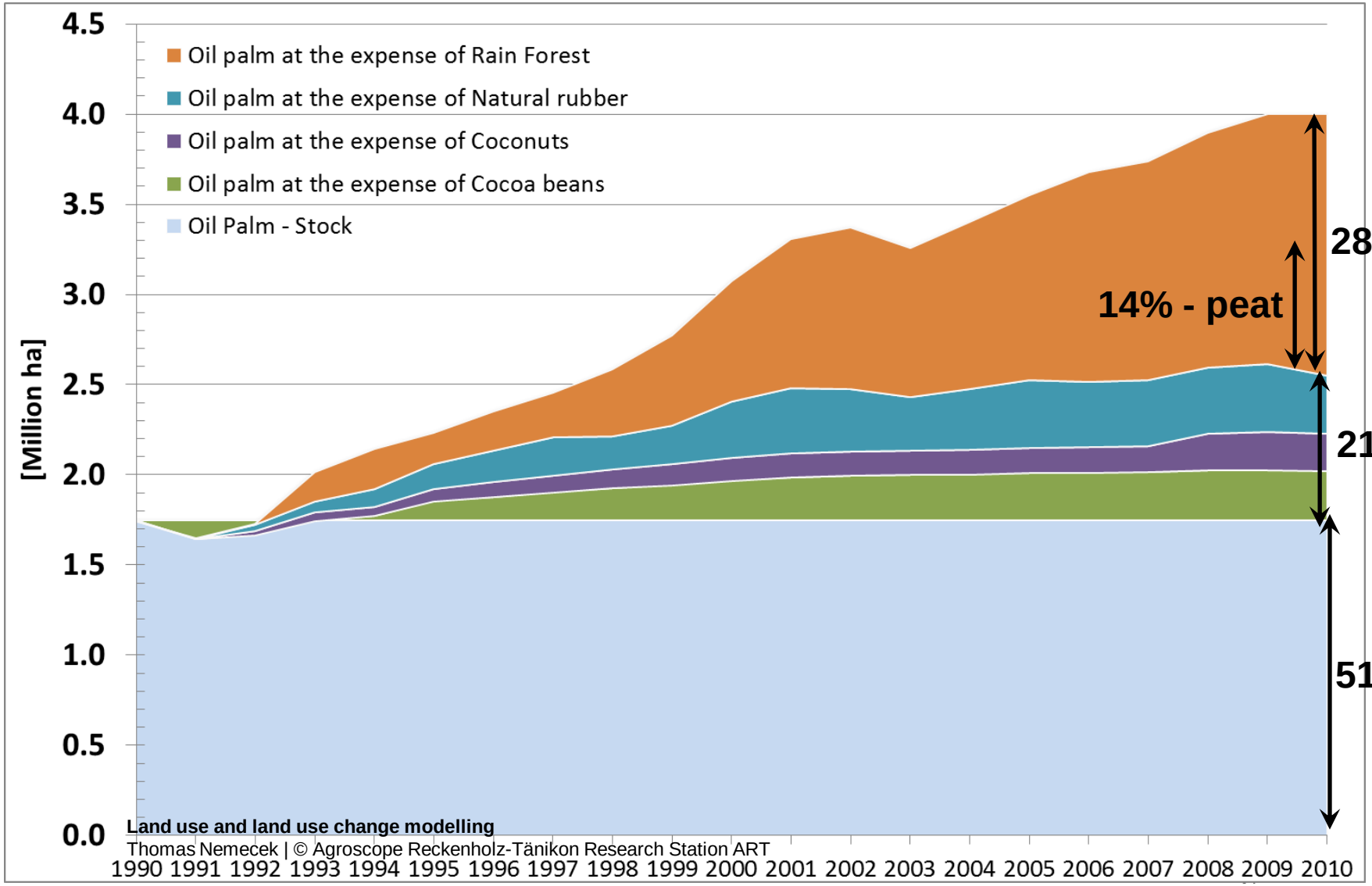
Concept for LCI modelling

➔ Separation according to transformation and occupation impacts



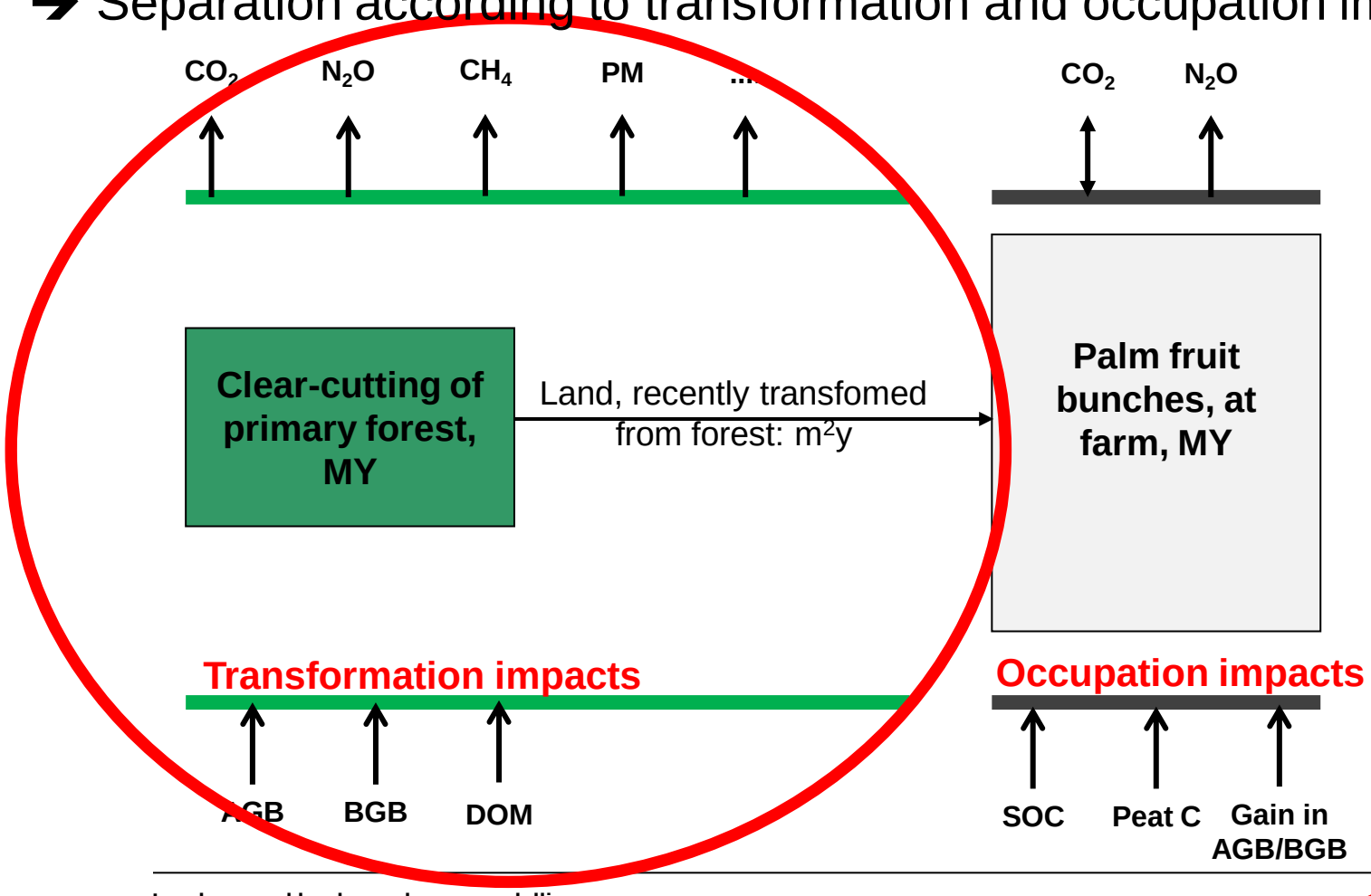
➔ 1. Direct land use change per kg crop?

Area cultivated with oil palm, MY, 1990-2009



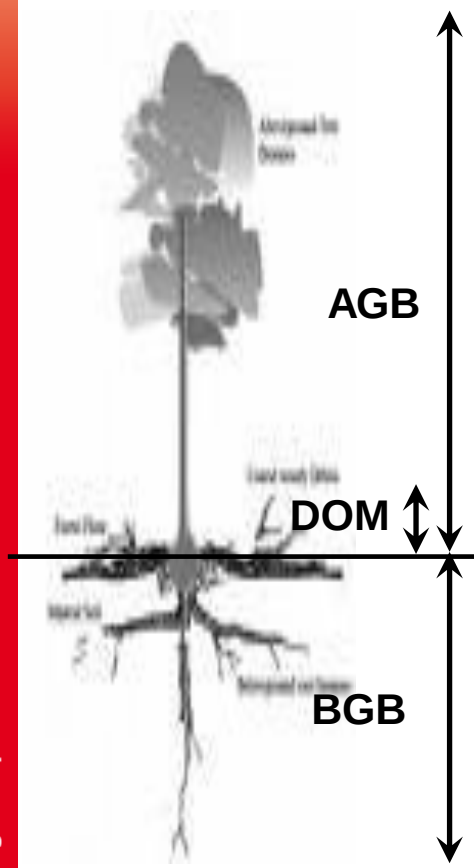
Concept for LCI modelling

➔ Separation according to transformation and occupation impacts



➔ 2. Modelling of land transformation?

Modelling of land transformation (clear-cutting activities)



Ecoinvent V.2.2

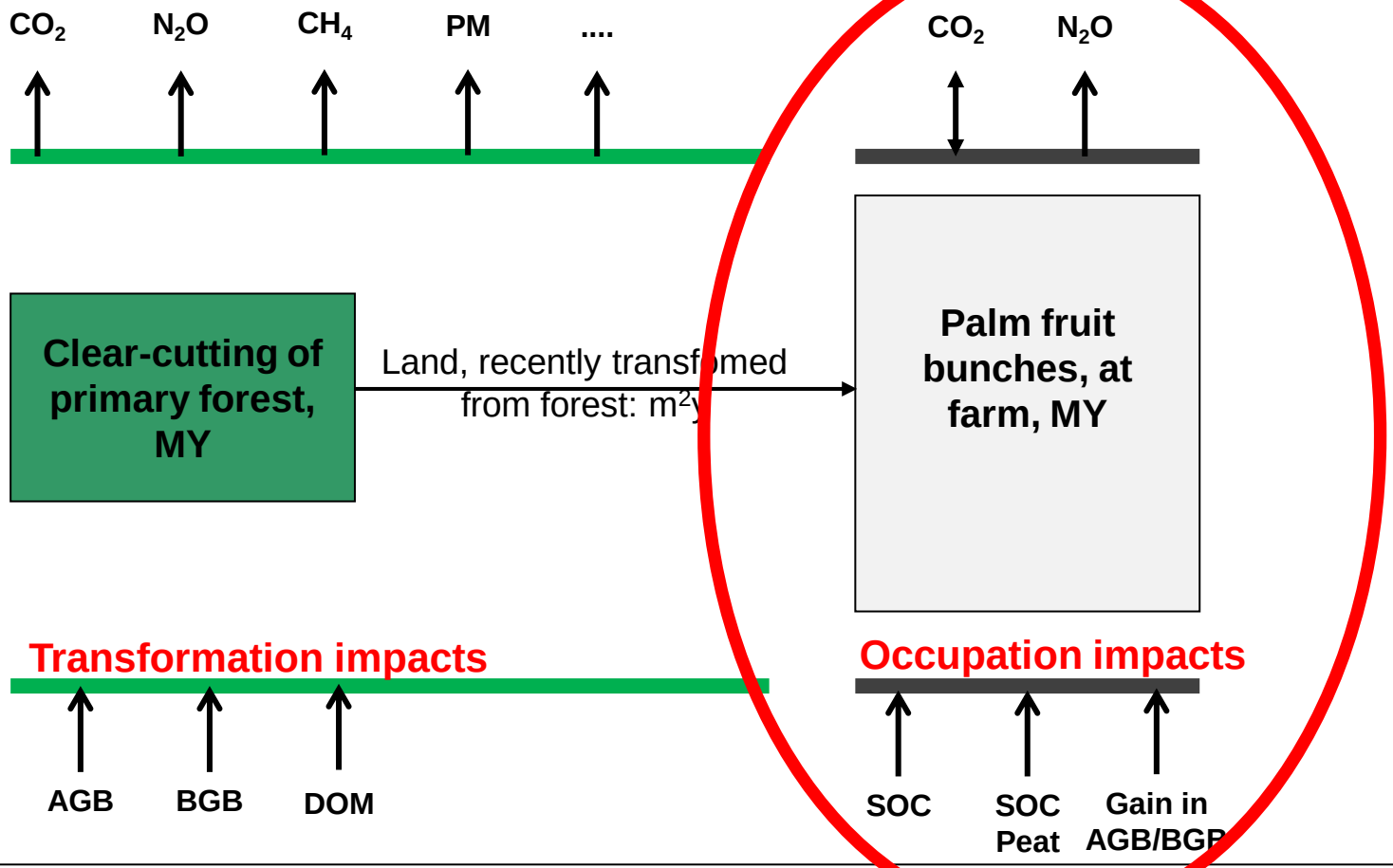
- AGB, 8% = harvested
- AGB, 20% = burned
- AGB, 72% = (left as slash, n.c.)
- BGB, DOM = n.c.

Ecoinvent V.3

- AGB, 8% = harvested
- AGB, 20% = burned
- AGB, 72% = released as CO_2 (decay of biomass)
- BGB, DOM = released as CO_2 (decay of biomass)

Concept for LCI modelling

➔ Separation according to transformation and occupation impacts



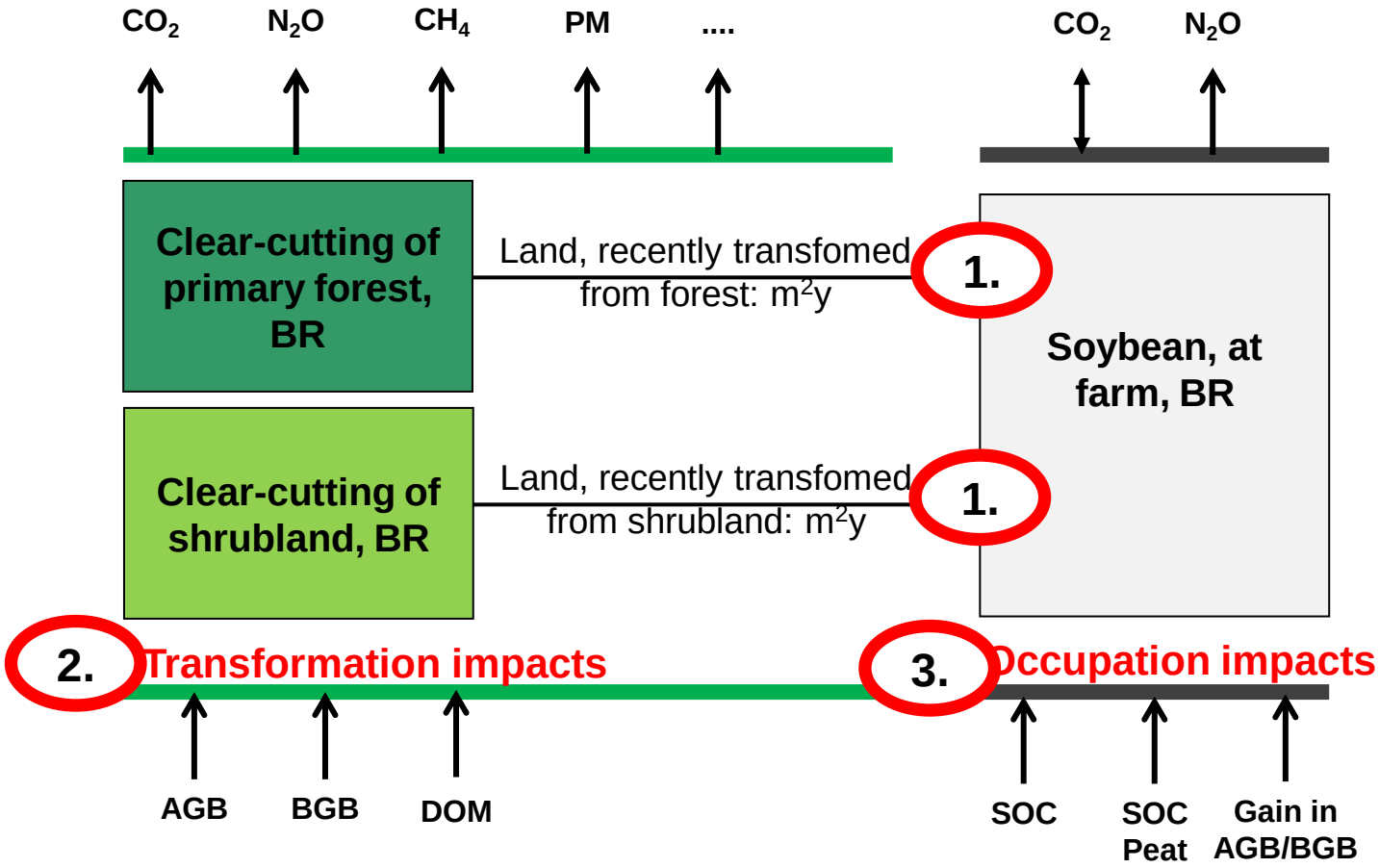
➔ 3. Modelling of land occupation?

LUC emissions from land occupation

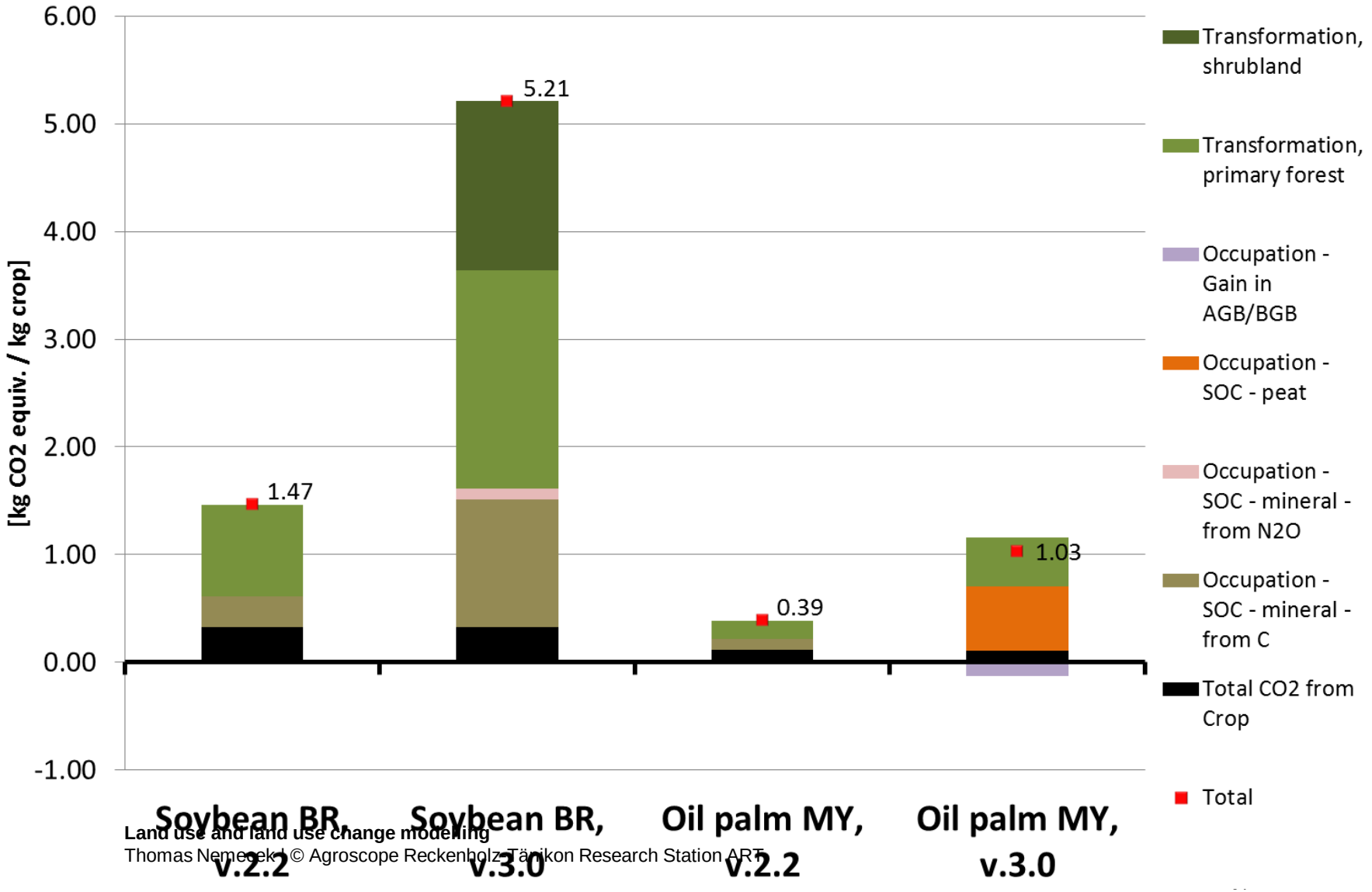
- Three main components considered:
- 1. Loss/gain of SOC from/in mineral soil ➔ release of N2O
  - Factors for land use and management given by IPCC 2006
  - Losses only considered for land transformed from native vegetation
  - Gains only considered for land already in use
- Loss of SOC from peat soil
  - Annual emission factor (29 t C/y-1)
- Accumulation of C in AGB/BGB
  - Only considered for permanent crops ➔ annual crops = zero
  - NOT considered for land transformations within one land use category, e.g. plantation to plantation.

Concept for LCI modelling - Soybean

➔ Separation according to transformation and occupation impacts



Overview: Results



Conclusions

- Updated LUC inventories:
  - Emissions from LUC are highly relevant
  - Attribution of direct LUC = high uncertainties
    - Time period, causality
  - Parameterized activities
    - Fast adaptation to site-specific conditio