SUSTAINABILITY IN BUSINESS

40th LCA Discussion Forum

Why to assess gravel use – and which gravel?

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Content

- **The questions**
- **Results & Learnings from a new LCA study on recycled vs. natural gravel / aggregate and concrete**
- **Thoughts on gravel assessment**

Starting points

- **Gravel is a resource**
- **Gravel is in soil. Getting access needs machinery etc. Their effects are obviously included in LCAs**
- **But for the resource itself, nobody cared - neither NGOs nor in LCA.**
- **The Swiss BAFU, however, cares (as do other authorities): It asked to include 'gravel use' into UBP'06**
- **What are the first learnings? What should stay, what should be improved`?**

Experience with the 'gravel ecofactor': The aggregate LCA 2010

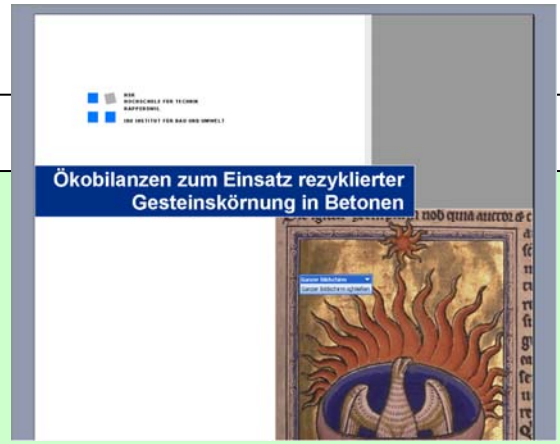
- **LCA for Aggregate ('Gesteinskörnung'; Kies etc.) and Concrete (Kytzia et al., 2010, publ. pend.; commissioned by Holcim (CH) AG)**

- **Question: Is it environmentally useful to use recycled aggregate in concrete?**

- **4 LCAs:**
  - **➔ LCA for aggregate types**
  - **➔ LCA for concrete with & without recycled aggregate**
  - **➔ LCA for a generic building project**
  - **➔ LCA for a Swiss region**

- **Background of the study: Environmental building standard 'Minergie P-Eco' asks for 25 % recycled aggregate in concrete, if available in the area.**
  Holcim wanted a scientific basis for their internal further strategy discussion and for the public discussion on concrete recycling.

The aggregate LCA 2010: Key results



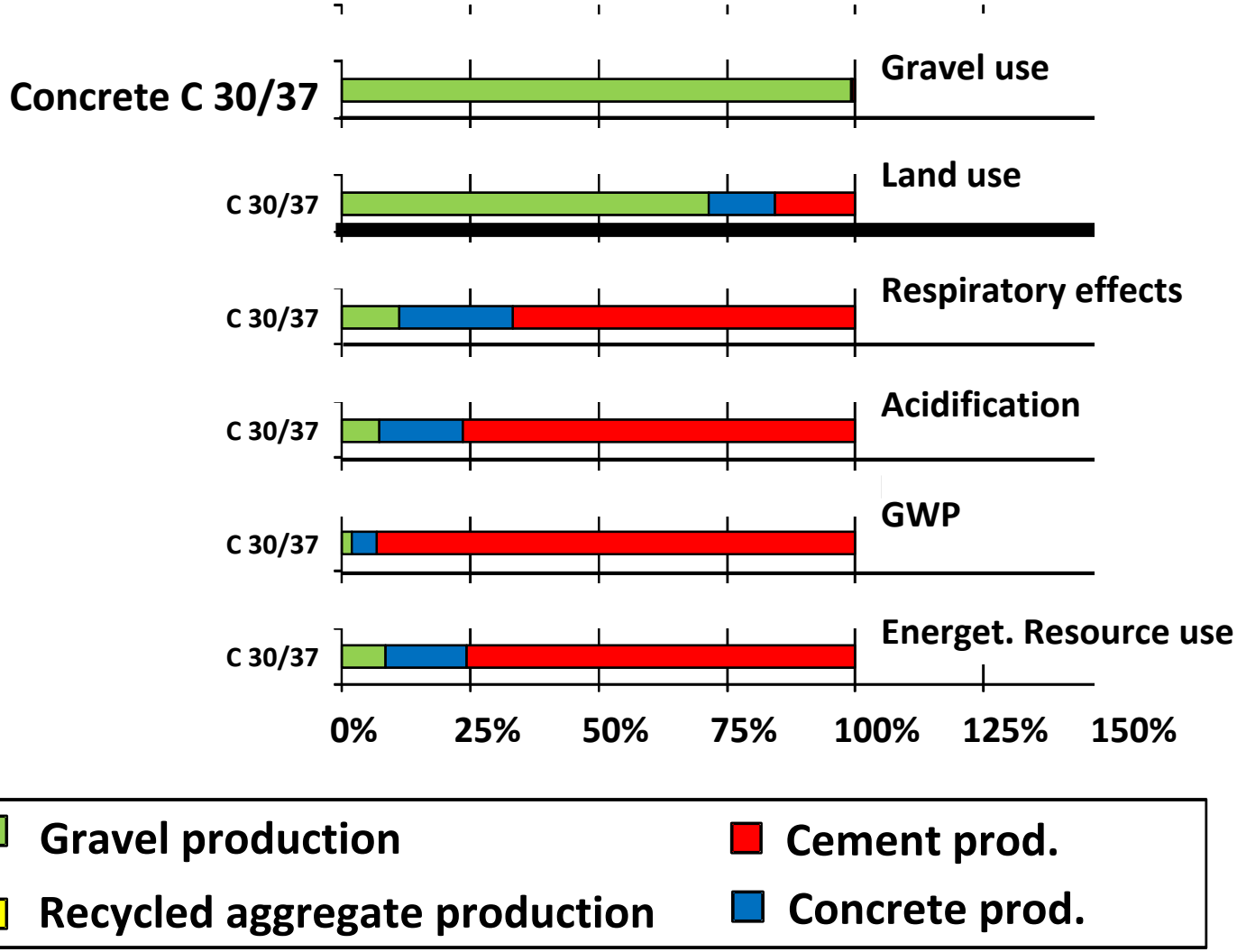
- **Basic results** ("Ökobilanzen zum Einsatz rezyklierter Gesteinskörnungen in Betonen"; Kytzia et al., 2010, publ. pend.)

- **Using recycled aggregate**
  -- reduces 'gravel use' and 'ecosystem damage', as well as the waste stream
  -- for low quality concrete reduces the airborne impact categories (GWP, AP, respiratory effects)
  -- for high quality concrete does not influence to a relevant extent energy use and airborne impact categories (GWP, AP, respirat. Damage)

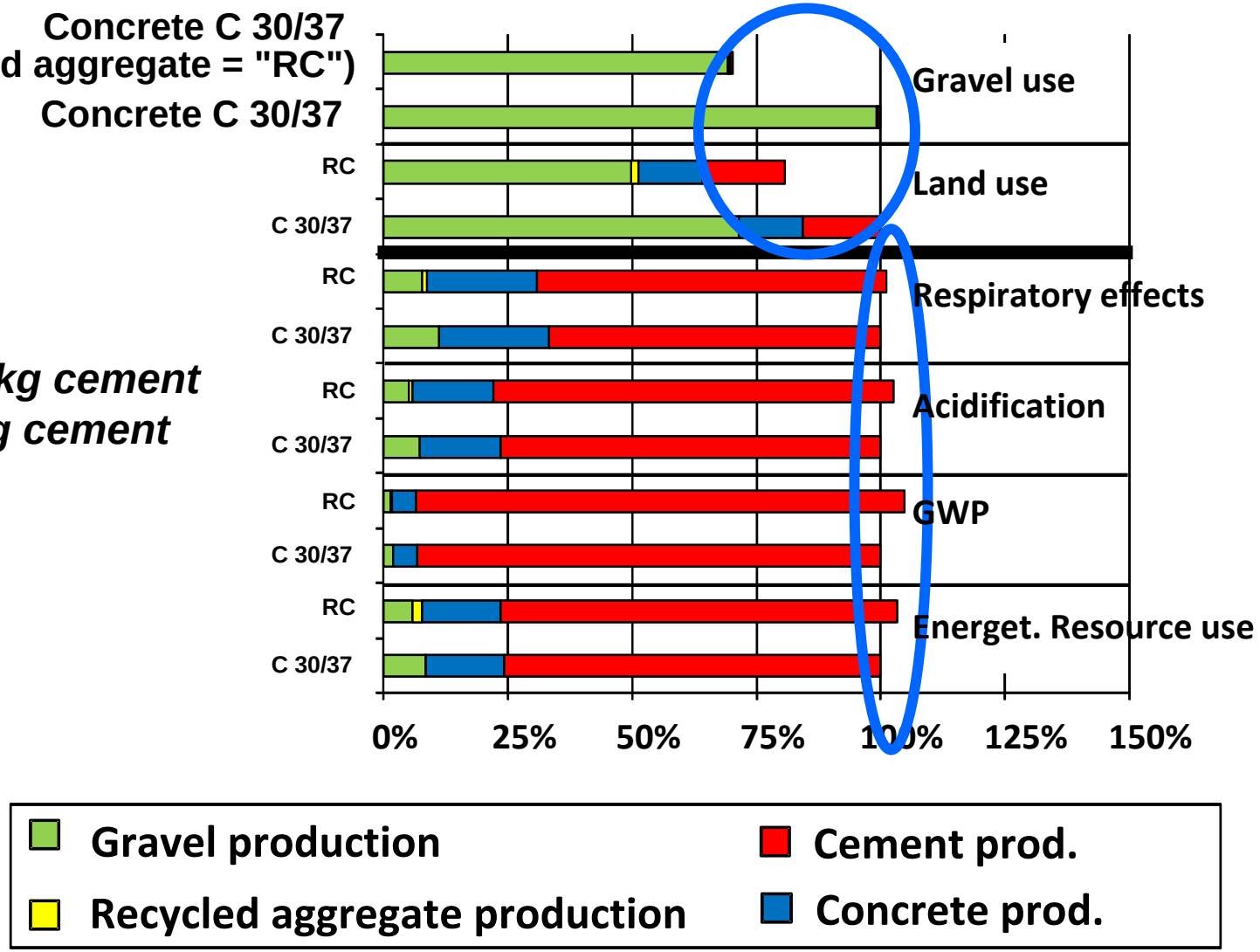
- **Reason for the latter: high quality concrete with recycled aggregate needs a higher cement content.**

- **Transport of recycled aggregate becomes very relevant @ > 30 km**

The aggregate LCA 2010: Results on high quality concrete (1)



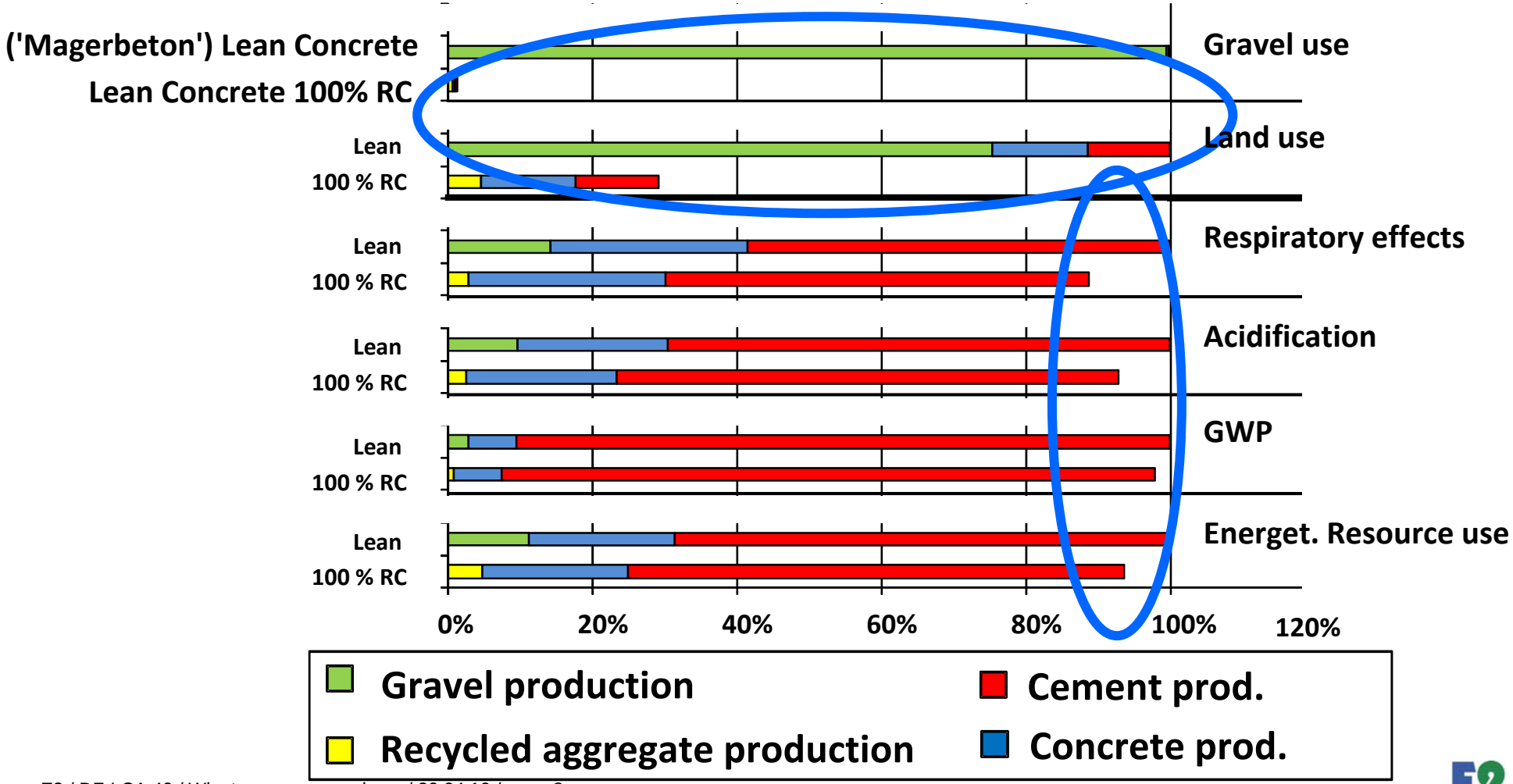
The aggregate LCA 2010: Results on high quality concrete (2)



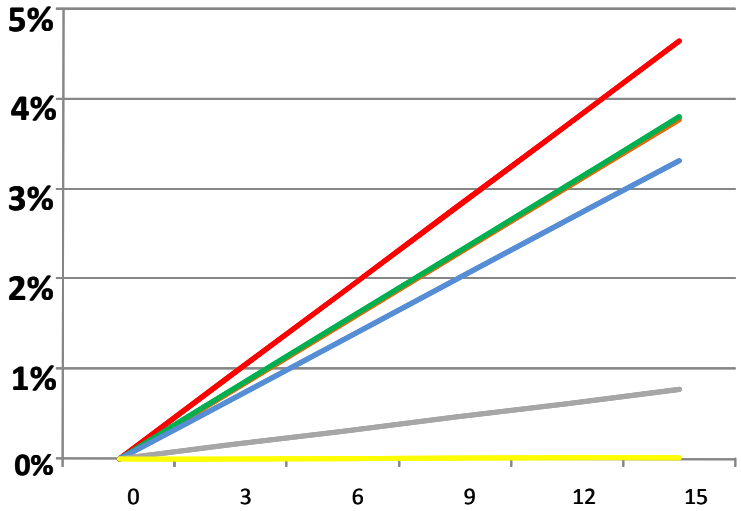
Note:
RC 30/37: 320 kg cement
C 30/37: 303 kg cement

The aggregate LCA 2010: Results on low quality concrete

Comparison for 0 et 100 % RC; both w/ 200 kg cement



Sensitivity Analysis: Cement content, Recycled aggreg. content

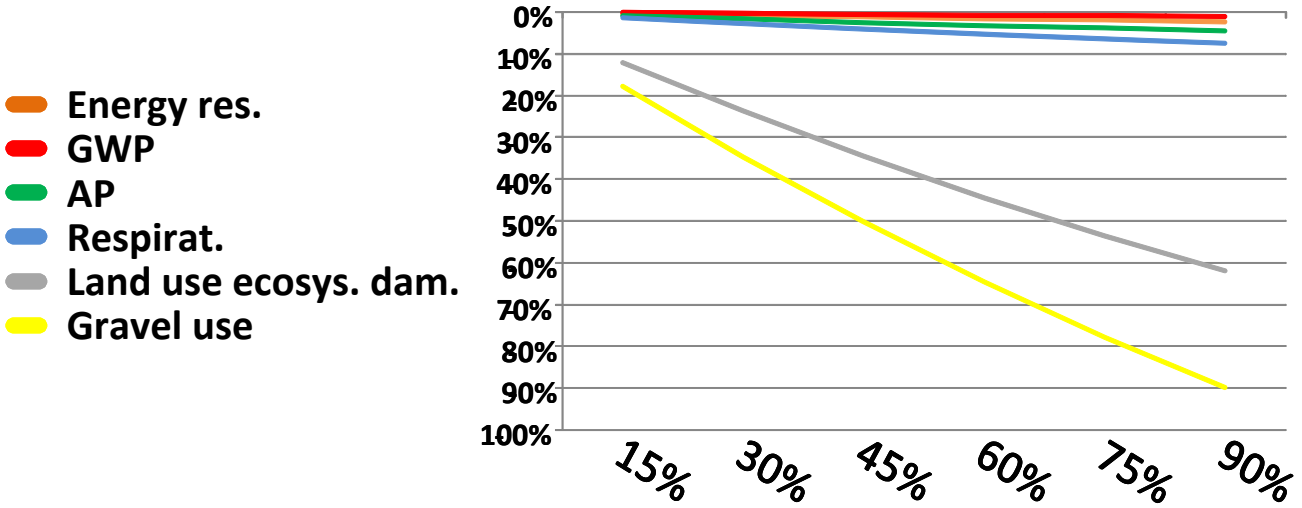


Increase in cement content (based on 303 kg = 100 %)

Cement content:

Effect on emissions

No effect on resource use



Recycled aggregate share of total aggregate

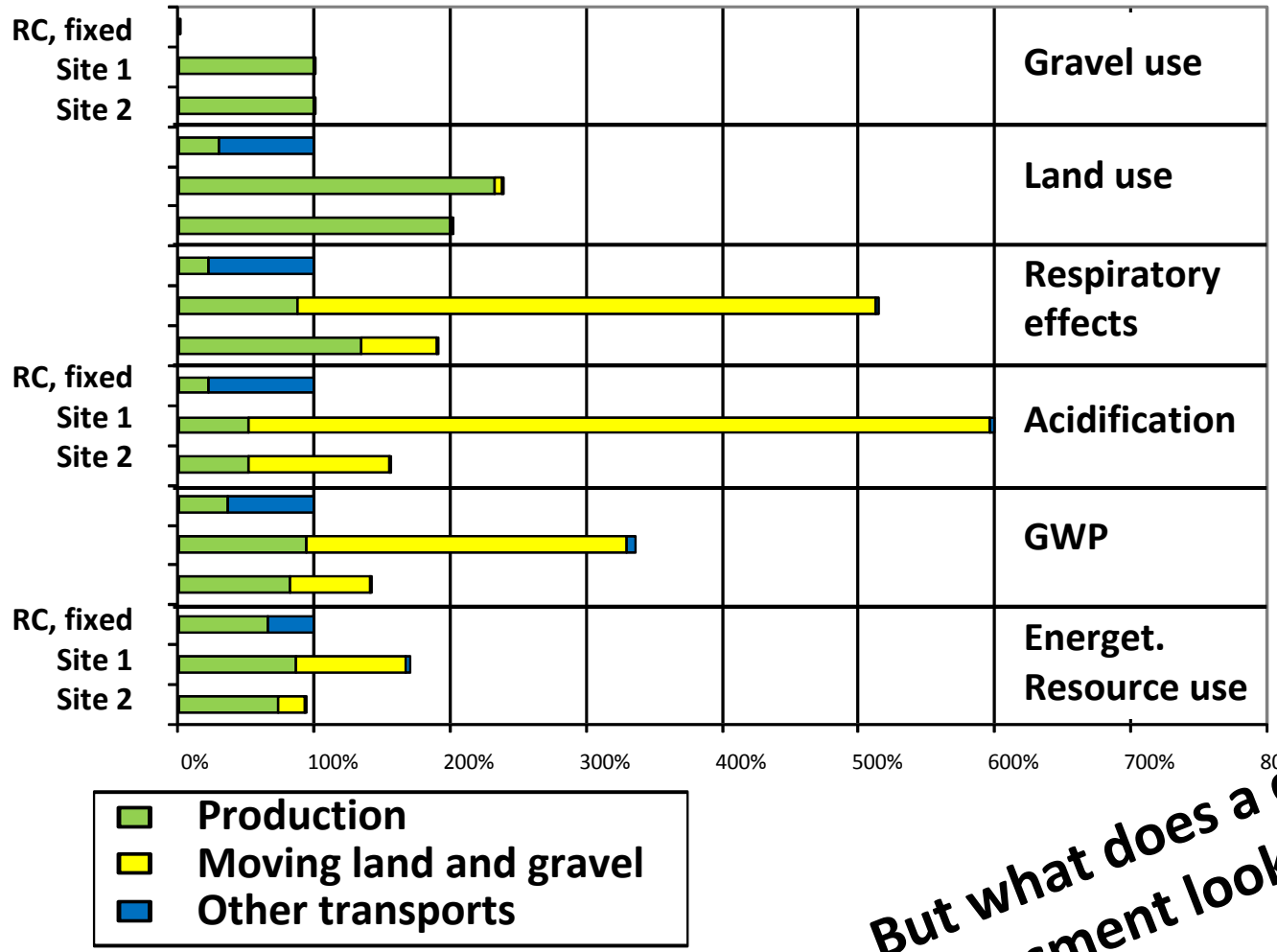
Recycled aggregate content:

Effect on gravel use & land use (?)

No effect on emissions

Gravel / Aggregate production: New (ranges) and RC (generic)

Data sources:
- **RC, fixed: adapted from ecoinvent**
- **Site 1, Site 2: Holcim**



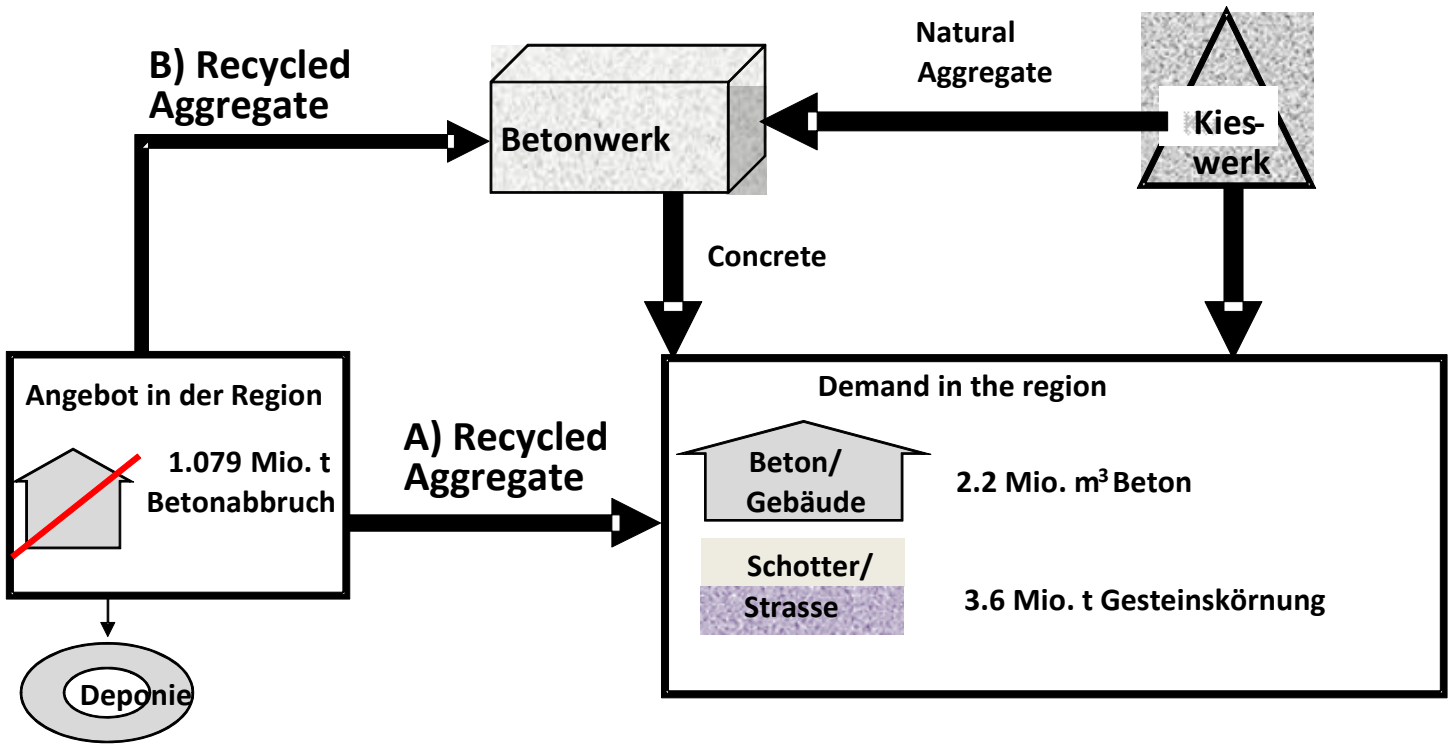
But what does a combined assessment look like?

Regional assessment

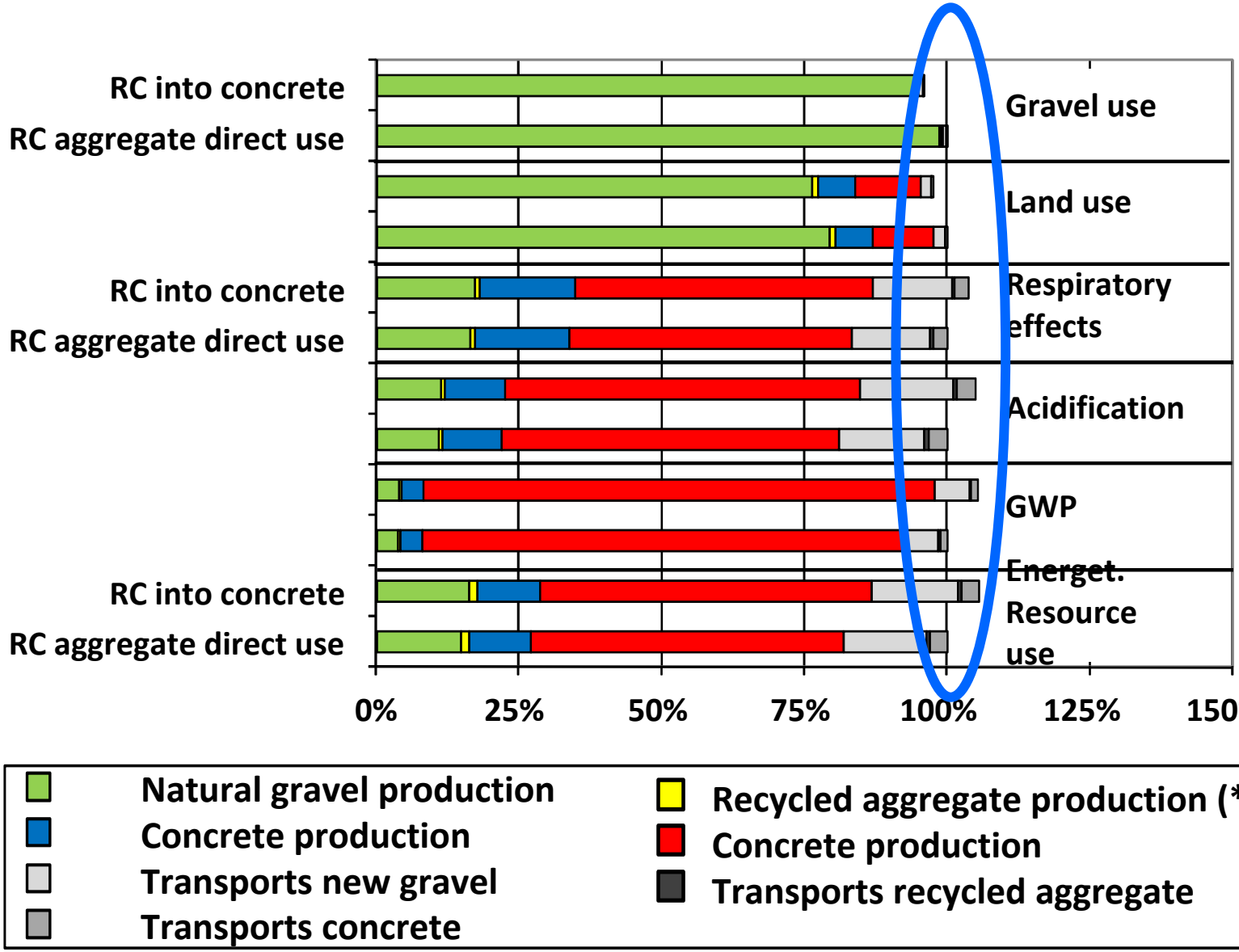
Assumptions:

- **<u>All</u> torn down concrete is used for RC (except 5 % waste), ..**
- **.. either for direct (loose) application, e.g. as foundation, road bed, etc**
- **.. or in (RC-)concrete**

Scenario:



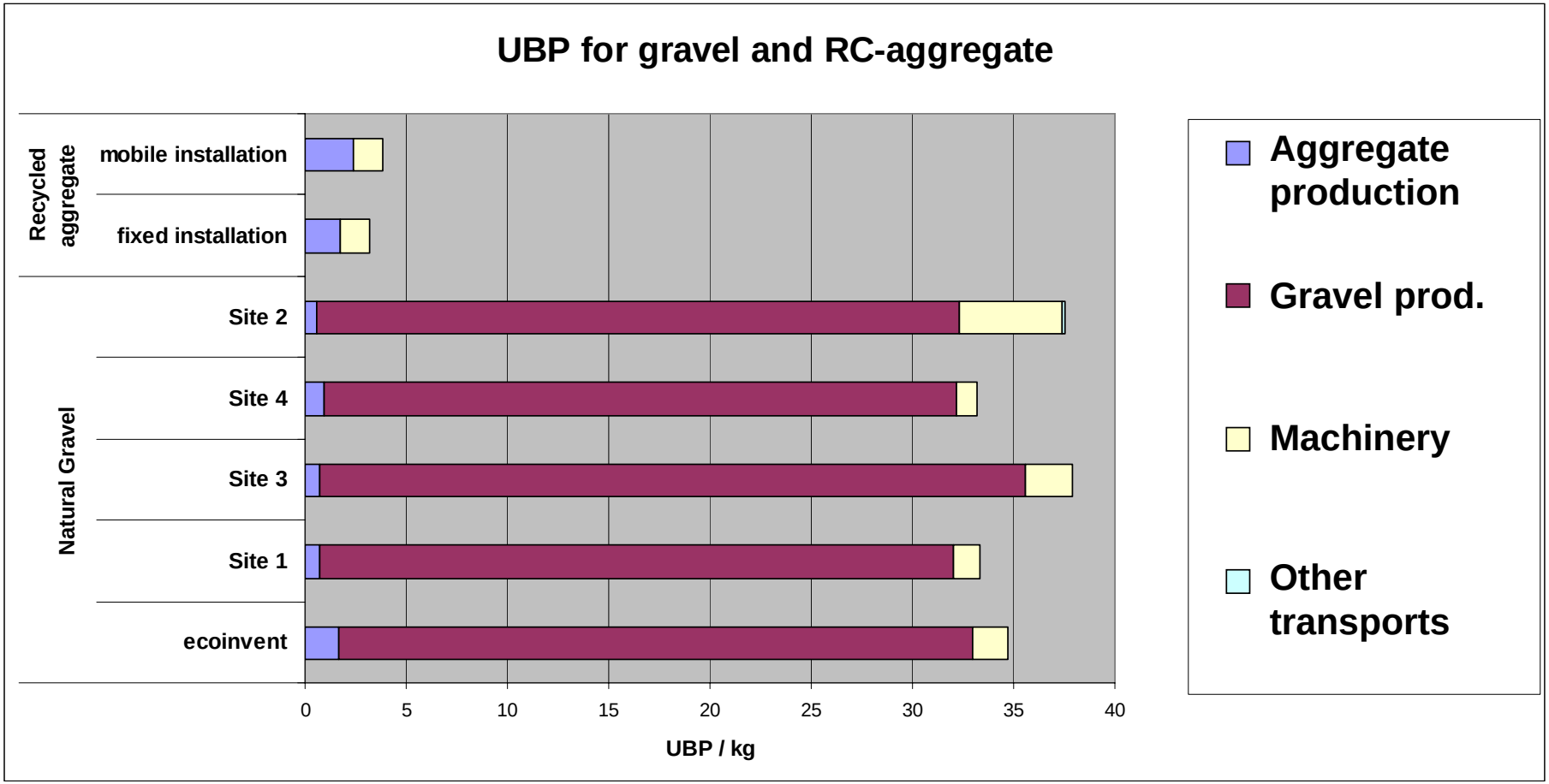
Regional assessment (w/ all old concrete used)



With these assumptions, it does not matter a lot <u>HOW</u> recycled aggregate is used.

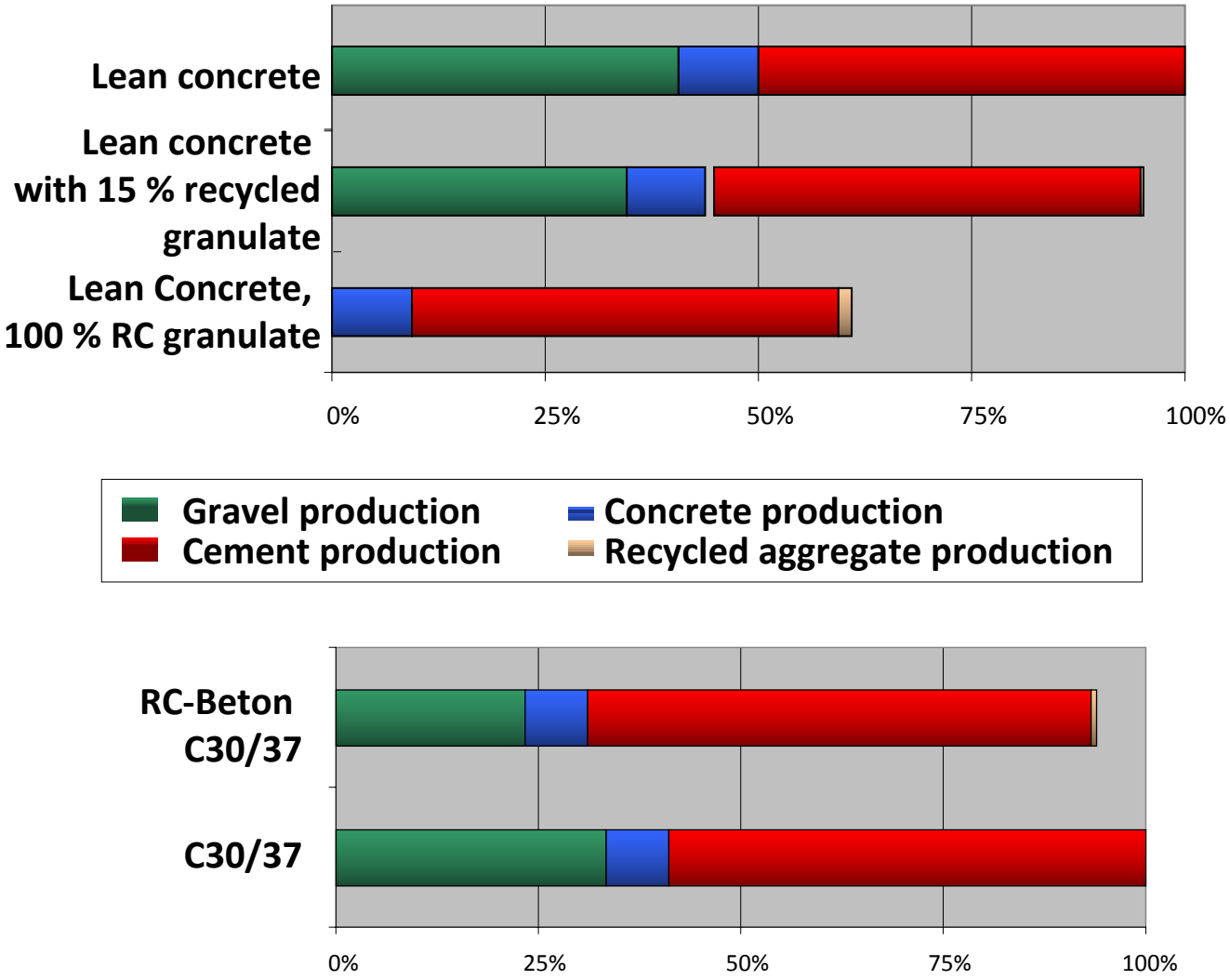
As long as it <u>IS</u> used.

UBP'06 results in gravel and concrete LCA (Kytzia, 2010; 1)



For aggregates, the gravel ecofactor dominates the assessment.

UBP'06 results in gravel and concrete LCA (Kytzia, 2010; 2)

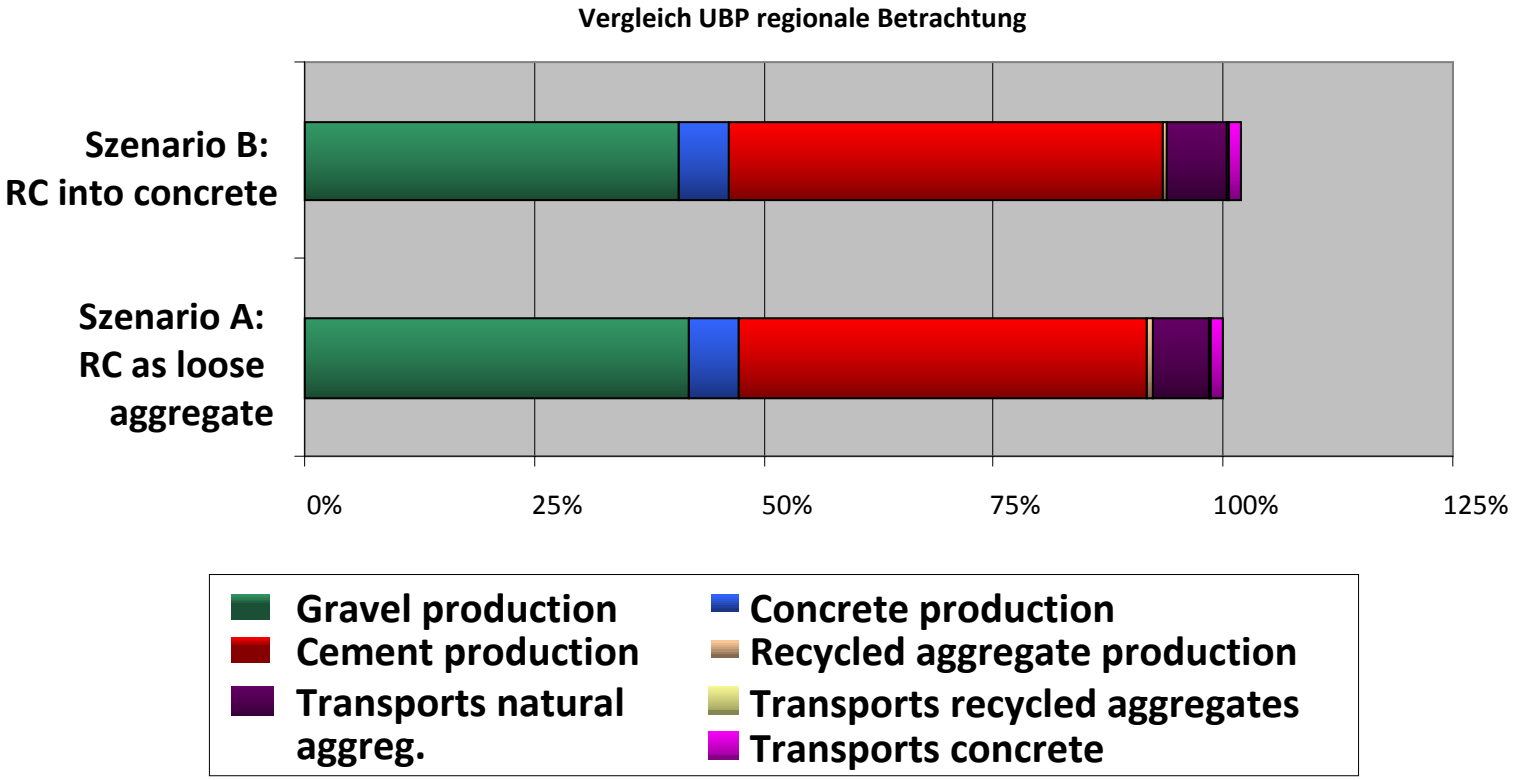


For concrete, the gravel effect is very relevant.

Lean concrete with high RC-content creates less environ. impacts

For high quality concrete, the gravel ecofactor's contribution is significant. But the overall result shows only small differences.

UBP'06 results in gravel and concrete LCA (Kytzia, 2010; 2)



On a regional scale:

IF all waste concrete is used, it does not matter if it is used in concrete or as loose aggregate!

Gravel in the UBP'06 method

New in UBP'06: Ecofactors (weighting factors) for:

- Fresh water
- Diesel soot ('Russ')
- Diocins and Furans
- Radioactive emissions to water
- PAK
- Benzo(a)pyrene
- Endocrine substances
- Land use
- Gravel use

Why an ecofactor for gravel in UBP'06?

- 'a resource *sui generis*, necessary for most building processes
  - 'not all gravel is accessible'
  - 'is a specific case of land use'
  - scarcity: current use = critical use

Is this a convincing case for inclusion into LCIA?

What abouts other stones, gold, diamonds?

Why & how put 'gravel use' as an environm. impact category?

WHY GRAVEL: WHAT SAFEGUARD SUBJECTS?

- 'resource sui generis'
- cleaning of rain water, ground water
- some land (shapes) used for gravel sites are protected

HOW TO INCLUDE:

- <u>as a spearate impact category?</u>
- include the gravel (soil) functions in similar impact categories (double counting? No function – resource, landscape, ground water – is covered fully in existing impact categories)?
- leave out?

Why & how put 'gravel use' as an environm. impact category (2)

WHICH MATERIAL SHOULD BE ASSESSED?

- **Gravel is heavy. Transports and landscaptes are regional: regional assessment like with sweet water?**
- **Only assess gravel which performs the functions, e.g.**
  - only gravel over aquifers?
  - only gravel in protected zones?
  - only 'round' stones (natural), but not stones? (Künninger: 85 / 15 %)
  - all other gravel to be left aside?
  Becomes too complex, not helpful.
- **Note: by defining an impact category, the overall weight of that imp. cat. in UBP only depends on the scarcity! Gravel (F = Fk) therefore has similar weight as e.g. Pesticides, Cu in water, or toxid waste.**

Why & how put 'gravel use' as an environm. impact category (3)

- **Basic issue of a non-renewable resource:**
  - time horizon? (10 yrs? 100 yrs? 100 yrs?)
  - current planning horizon? (10 – 20 yrs)
  - any +/- legal resource use yields "F = Fk" (current flow = critical flow)
- **To what extent is gravel different to other soil materials, such as clay, sand or other stones?**

- **My opinion: IF there remains an impact category on gravel (etc.), it should cover all exploited soil materials, or at least all hard soil materials.**