Indicative solution of the Mineral/Metal Scarcity I case (EN)

dr. Erik Pruyt

September 2012

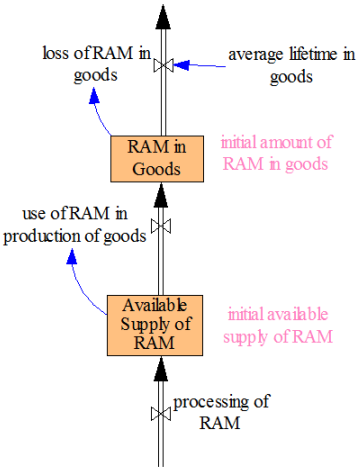
In this new Mineral/Metal scarcity case, based on (Pruyt 2010), students first need to make a small SFD, a detailed CLD and an aggregated CLD from the first description (see Figures 1(a)(b)(c)). This very simple submodel needs to be extended in two further steps: with the demand for REM (variables in yellow in Figure 1(d)) and mining/processing industries (variables in green in Figure 1(d)).

Students need to perform the necessary verification and validation tests, extend the model with an '*intrinsic demand*' structure and related scarcity output indicator, and simulate the behavior of key variables (see Figures 2(a) and 2(b)). Then students need to investigate what would happen if the '*initial extraction capacity under construction*' would be zero (see Figures 2(c) and 2(d)), and what would happen if the '*initial extraction capacity under construction*' would be zero and the 'economic growth rate' would amount to 3% instead of 5% from 2011 on (see Figures 2(e) and 2(f)).

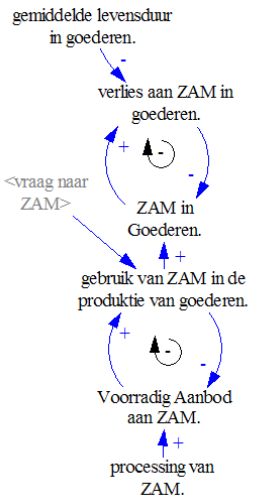
Following up on the what-if analyses, students need to perform a sensitivity analysis. Finally, they need to make an aggregated CLD of the model (see Figure 3) and explain the link between structure and behavior.

References

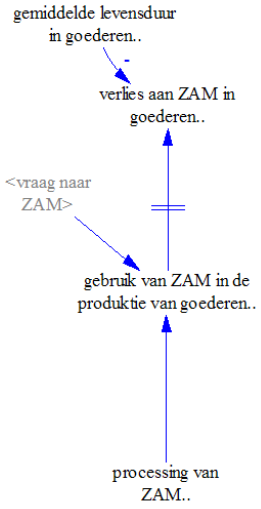
Pruyt, E. (2010, July). Scarcity of minerals and metals: A generic exploratory system dynamics model. In *Proceedings of the 28th International Conference of the System Dynamics Society*, Seoul, Korea. International System Dynamics Society. `http://systemdynamics.org/conferences/2010/proceed/papers/P1026.pdf`. 1



(a) First submodel



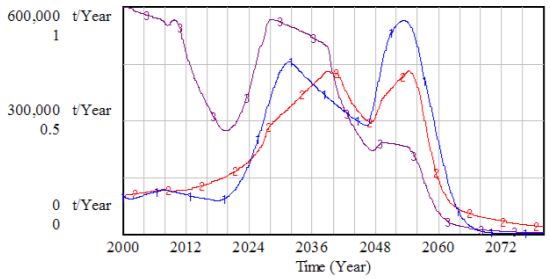
(b) Full CLD of first submodel



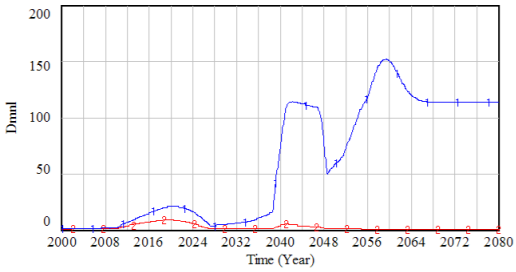
(c) Aggregated CLD

(d) Full SFD of the REM model

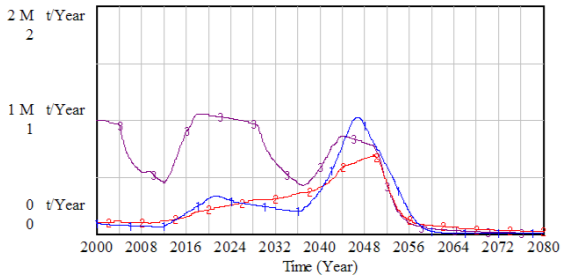
Figure 1: Partial SFD, partial CLDs, and full SFD of the REM model



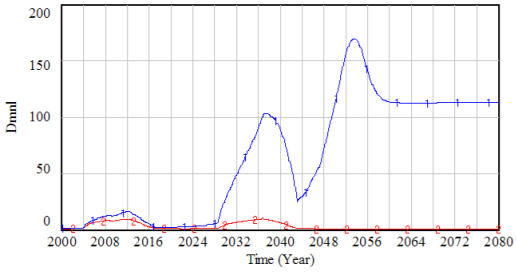
(a) Base case behavior: *installed extraction capacity* (blue –1–), *demand for REM* (red –2–), the output indicator (purple –3–)



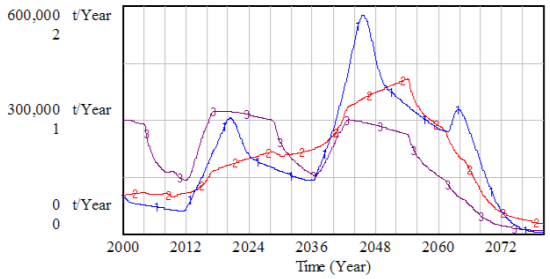
(b) Base case behavior: the *relative price* (blue –1–) and *scarcity price effect* (red –2–)



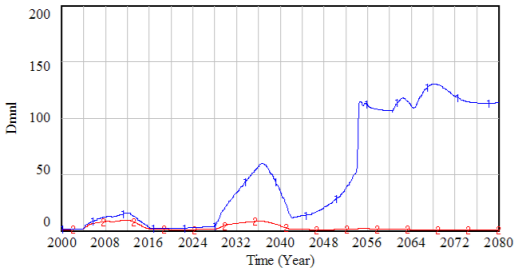
(c) What-if 1: *installed extraction capacity* (blue –1–), *demand for REM* (red –2–), the output indicator (purple –3–)



(d) What-if 1: the *relative price* (blue –1–) and *scarcity price effect* (red –2–)



(e) What-if 2: *installed extraction capacity* (blue –1–), *demand for REM* (red –2–), the output indicator (purple –3–)



(f) What-if 2: the *relative price* (blue –1–) and *scarcity price effect* (red –2–)

Figure 2: Left hand side: Base case and what-if behaviors of the *installed extraction capacity* (blue –1–), *demand for REM* (red –2–), the output indicator (purple –3–); Right hand side: Base case and what-if behaviors of the *relative price* (blue –1–) and *scarcity price effect* (red –2–)

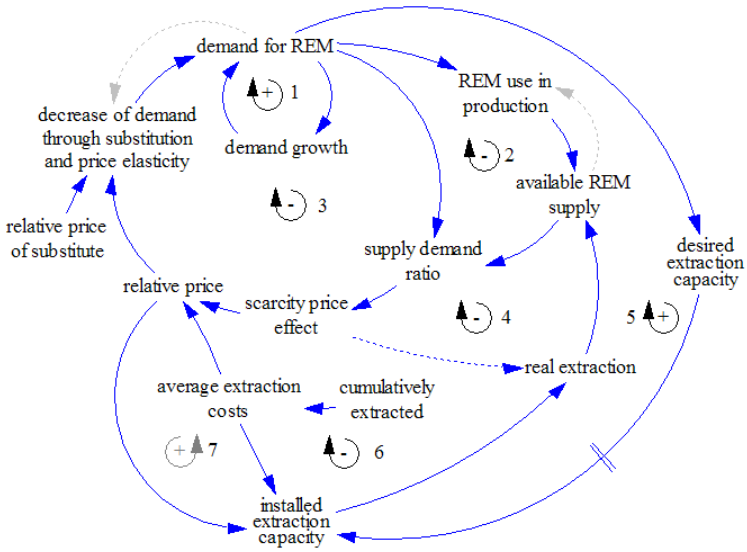


Figure 3: Aggregated CLD of the REM scarcity model