How can we implement a regionally contextualised LCA ?

Brought to you by:

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Video two- script

Well if you have seen our first video you will know that we tried to provide an overview of what we mean by setting regional contexts to orientate our LCA questions and projects and why this is important for a biobased economy.

In this video we will try to explain how we developed an LCA approach which fits to one of these contexts previously outlined.

Shot 1- Introduction

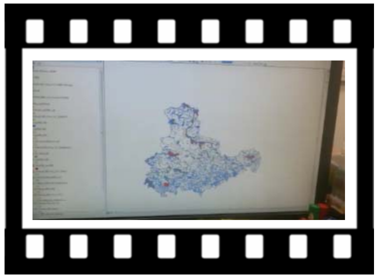
After we figured out the different contexts, we decided what we needed for our goal, which was to conduct a life cycle assessment for regional bioenergy systems already established – was a "within regional context".

With this the boundaries were set to the regional foreground, but of course not forgetting that our activities in the region, using an example of biodiesel production, can also lead to indirect or upstream (and downstream burdens) outside of the region.

Shot 2- RELCA modelling approach

So to start very simply we came up with a modelling approach, which we called "RELCA" . This is a REgional life cycle inventory for assessing the environmental burdens of producing a bioenergy product "within" a regional context.

Shot 11– there is some science behind all of this



While we explain it quite simply here, it must be noted that there is quite an extensive inventory required to be collected which is also regionally and spatially orientated, from plant locations to soil and climate data, to also finding an appropriate means of simulating potential regional cropping distributions. Much of this work is done with a combination of GIS, Mat lab and the life cycle assessment tools.

If you would like to find out more about the RELCA modelling approach you can take a look at our paper, it's a bit more scientificy.

O'Keeffe S, Wochele-Marx S, Thrän D. RELCA: a REgional Life Cycle inventory for Assessing bioenergy systems within a region. Energy, Sustainability and Society. 2016;6(1):1-19.

The objective of RELCA is to establish a regionally distributed life cycle inventory, which combines both regional bioenergy technologies with their associated biomass feedstocks for an entire region.

The main modelling steps involved:

Shot 3- First step CRAmod

Crop Allocation Modelling (CRAMod) to generate the potential biomass availability or regional distribution of energy crops which can theoretically be used by regional bioenergy systems.

This was done by combing regional cropping statistics with crop preferences such as soil, climate or field slope.

Shot 4– Second step BioMod

Biomass inventory Modelling (BioMod) was used to develop the mass and energy balances (inputs and emissions) relating to the cultivation of the associated energy crops used in the bioenergy system of interest. This was done for each grid cell which we had allocated across our region.

Shot5 - CPMod

Conversion Plant Modelling (CPMod) was used to develop representative bioenergy plant models (process based) for the bioenergy conversion systems in the region, along with determining their spatial distributions across the region. In other words where were they located?

Shot 6– 4th Step- CAMod

The Catchment allocation modelling step (CAMod) was used to assign the regionally distributed bioenergy crops to the various bioenergy conversion plants across the region.

Shot 7– Summing of up steps

Steps 1-3 deal mostly with calculating the direct mass and energy flows as well as emissions i.e. those generated within our region such as soil nitrous oxide or exhaust emissions from tractors harvesting biomass. In these steps we also calculate the demand for importing different auxiliaries into our region as a result of producing biodiesel, how much fertiliser is used diesel or pesticide, for example.

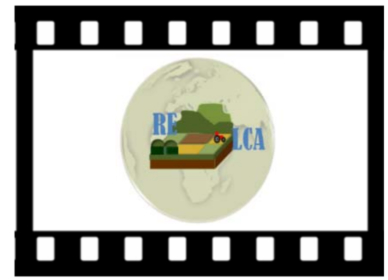
What we do then to tie up all the calculations done in the previous steps is to then use catchment delineation, which sums up all the inputs and emissions and associating them with the related individual biodiesel plants. With this we can then link to the 5th and final step.

Shot 8- NORIMod

Non-Regional Inventory Modelling (NoRIMod) was used to identify and link the indirect upstream emissions, to the direct emissions produced within the region. Upstream emissions are assumed to be produced externally to the region.

Shot9 – What do our results look like?

As proof of concept we used RELCA to simulate the GHG (greenhouse gas) emissions associated with producing 1MJ of biodiesel. This let us know the performance of each biodiesel catchment within our region and the potential trends of GHG emissions and thus the environmental performance of our regional biodiesel production in relation to climate change.



Shot10 – Hotspot analysis

We could also explore the results in many interesting ways. One example was a Hotspot analysis here we use GIS software to tell us where our GHG emissions are statistical higher within our region “Hotspots” or where they are statistically lower, shown here in red and blue respectively. Thus, giving us an idea of which conditions or management practices may need to be altered within our biodiesel configurations in order to bring the regional GHG balances down.