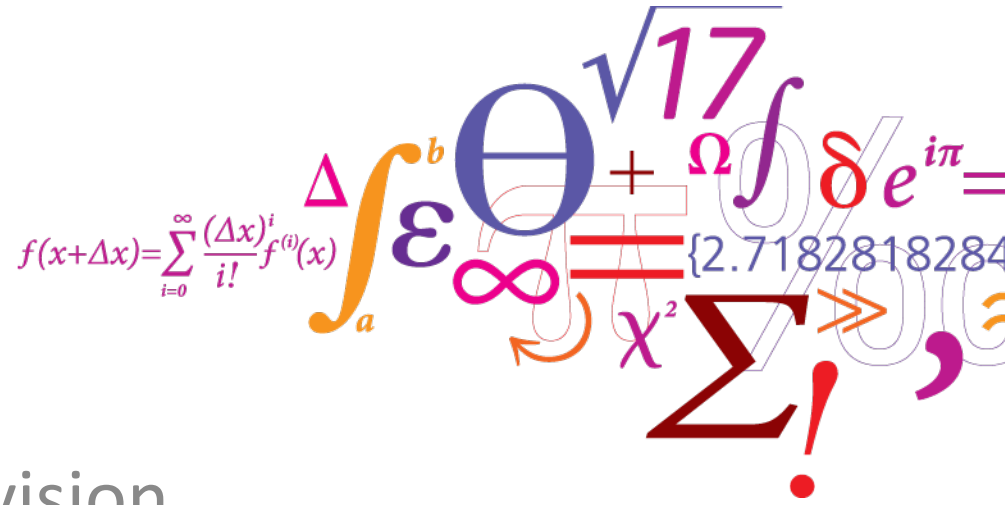
# Circular economy in the meat processing sector – using life cycle assessment (LCA) as a screening tool



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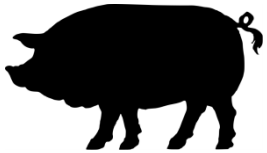
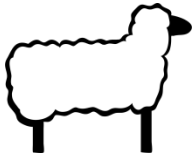
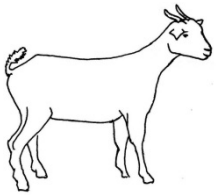
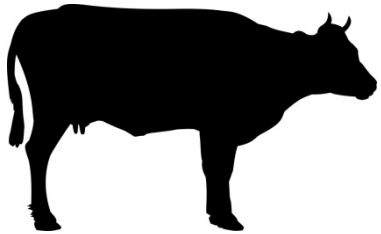
# Conceptual framework for applying circular economy concepts

1) Life cycle inventory of site
2) Benchmark using inventory
3) Identify opportunities
4) Identify constraints
5) Gate-to-gate LCA of current operation
6) LCA to assess options

# 1. Inventory of current operation



RENDERING






LPG







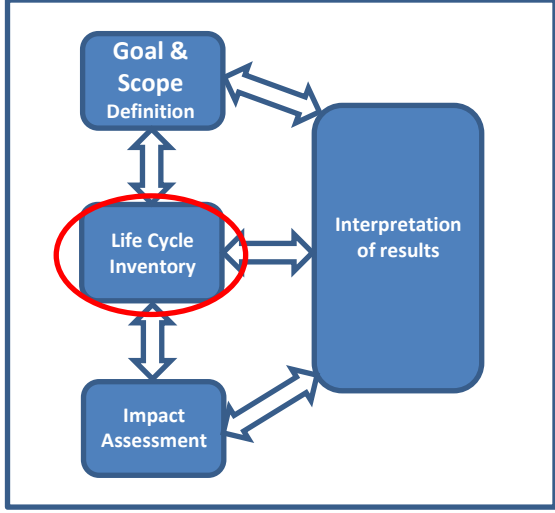




SALT

REFRIGERANT
134a


# 2. Benchmarking



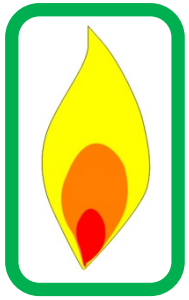

- Primary consumption data
  - kWh Electricity - MJ Boiler fuel
  - kL Transport fuel (diesel, petrol)
  - Total MJ energy use
  - Water use - Wastewater generation
  - Wastewater quality - Production (t HSCW)

→Compare to industry data (relevance?)

→Identify efficiency target

→Site identified electrical efficiency projects to reduce demand

# 3. Resources & Opportunities





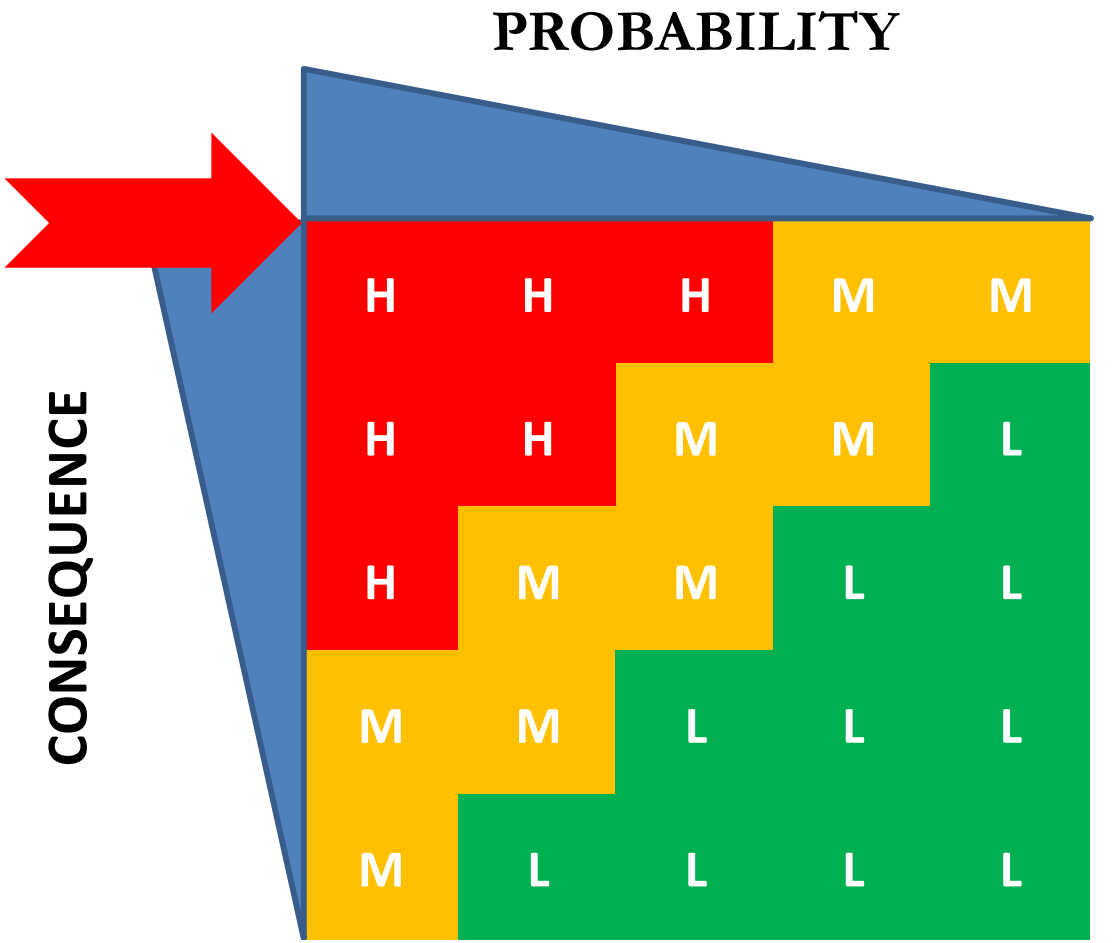
# 3. Relative cost ranking (fuel only)

$X per MJ

$0.5X per MJ

$0.1X per MJ

# 3. Supply chain risks



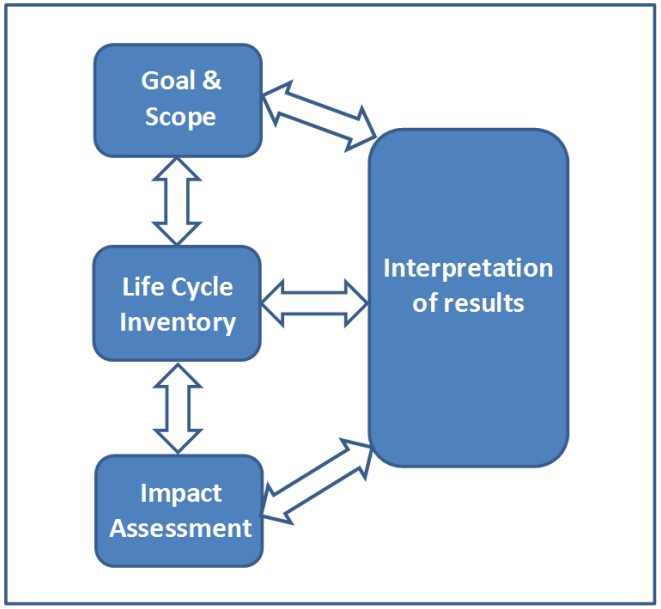

# 4. Constraints

Q fever

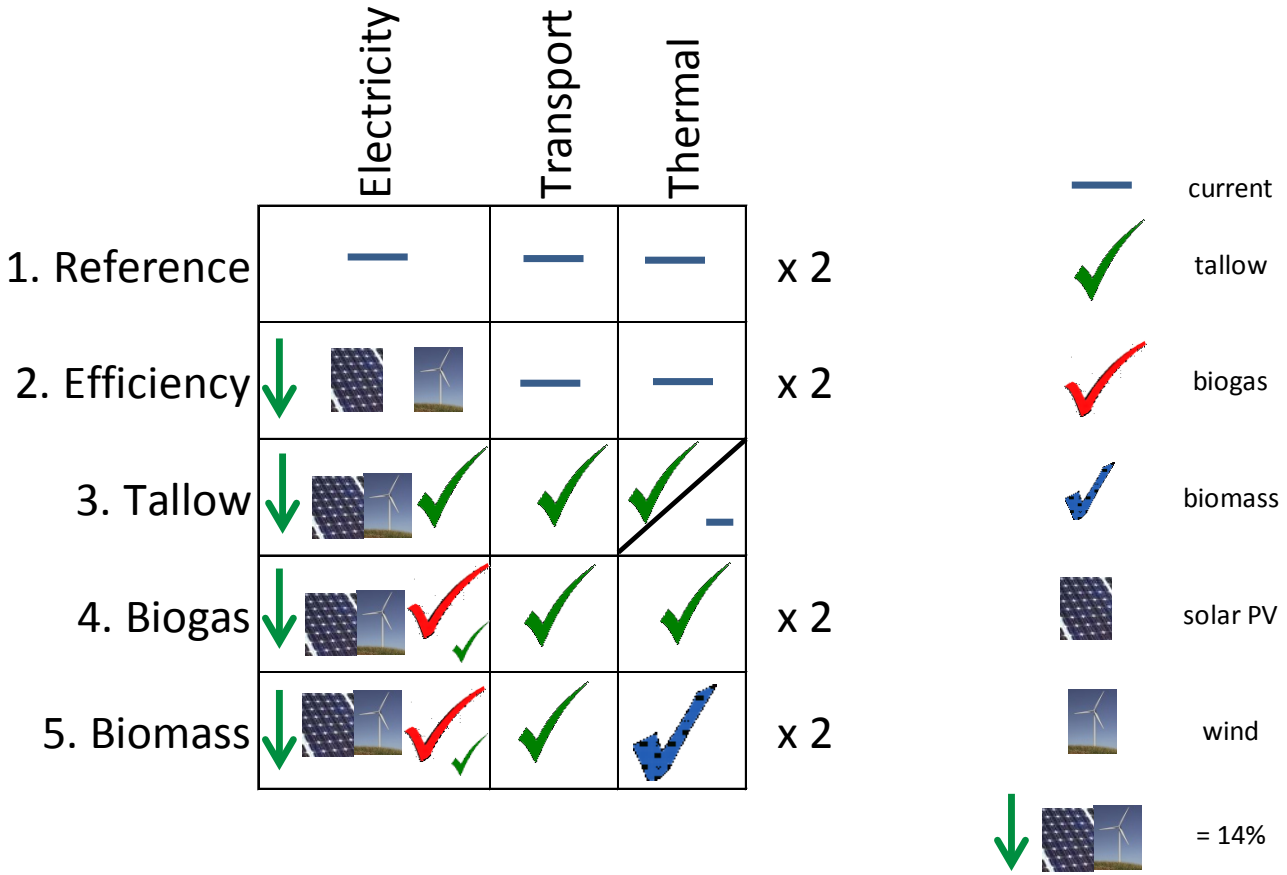
Use for bioenergy

# 5. Goal & scope

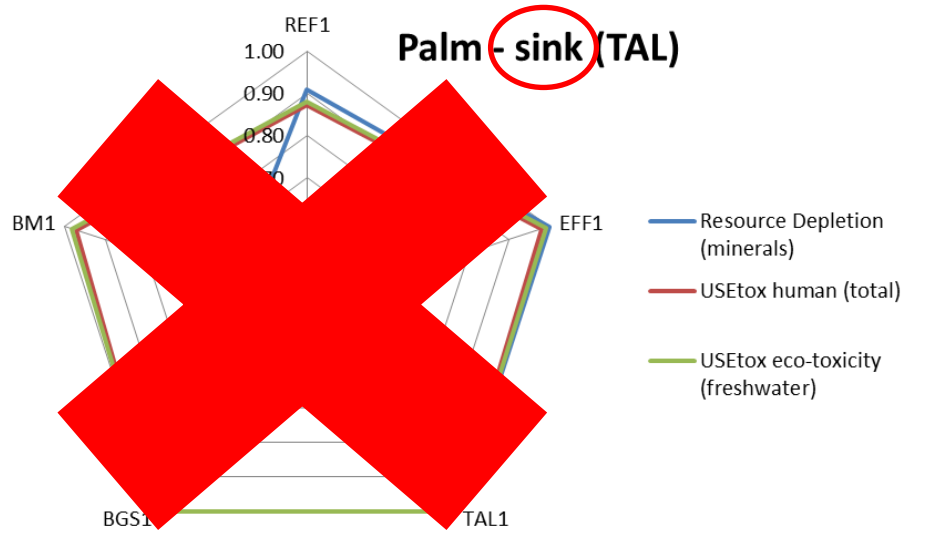
- Goal
  - Identify which internal processes to focus on (current)
  - Identify optimal alternative energy options (future)
- Gate to gate LCA of plant only
- System expansion to handle coproducts
  - Tallow
    - global tallow market
    - palm oil
  - Edible offal – live weight cattle
  - Hides – polyethylene fleece
  - Meal – rape meal

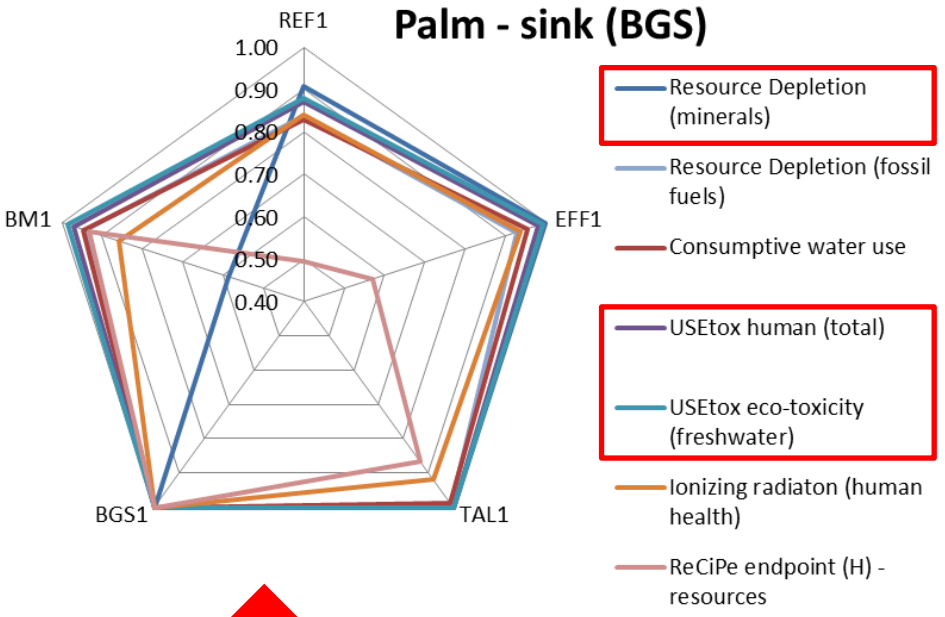


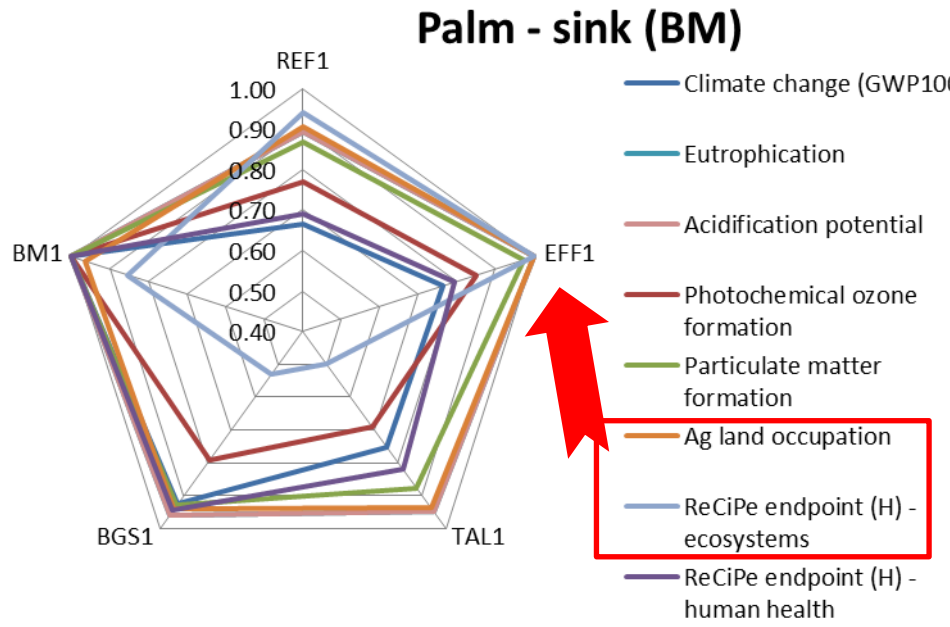
# 5. Modelling scenarios



# 5. Modelling results - palm

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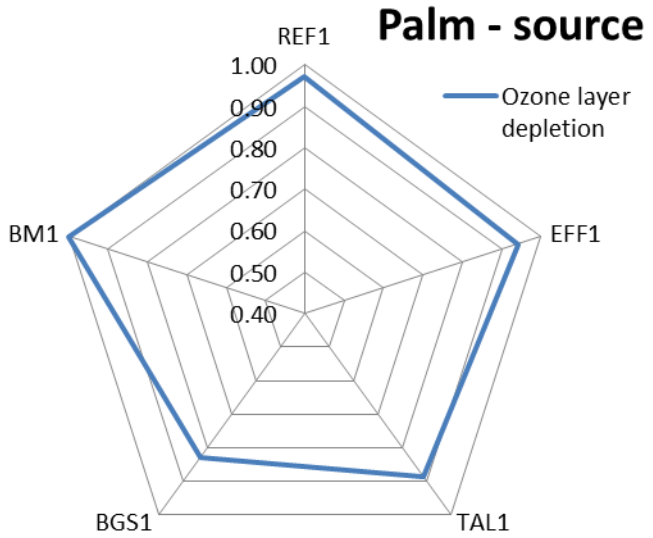
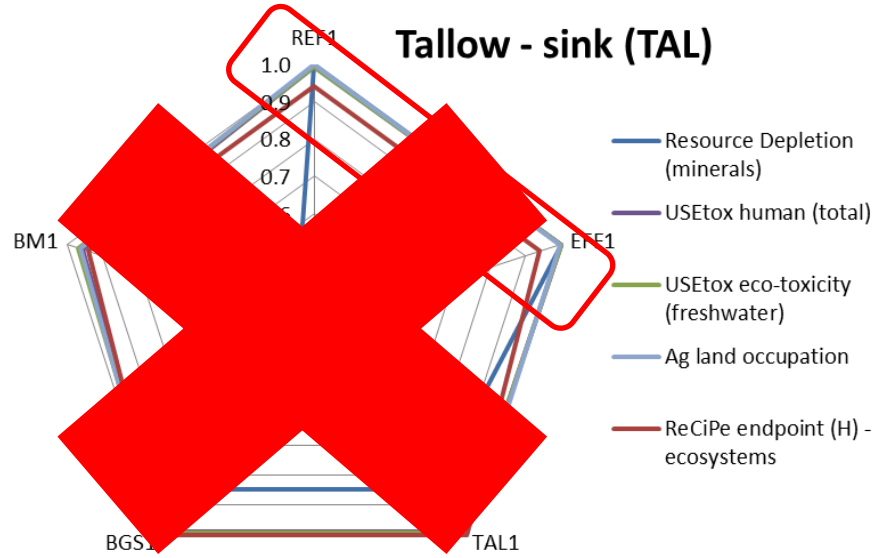
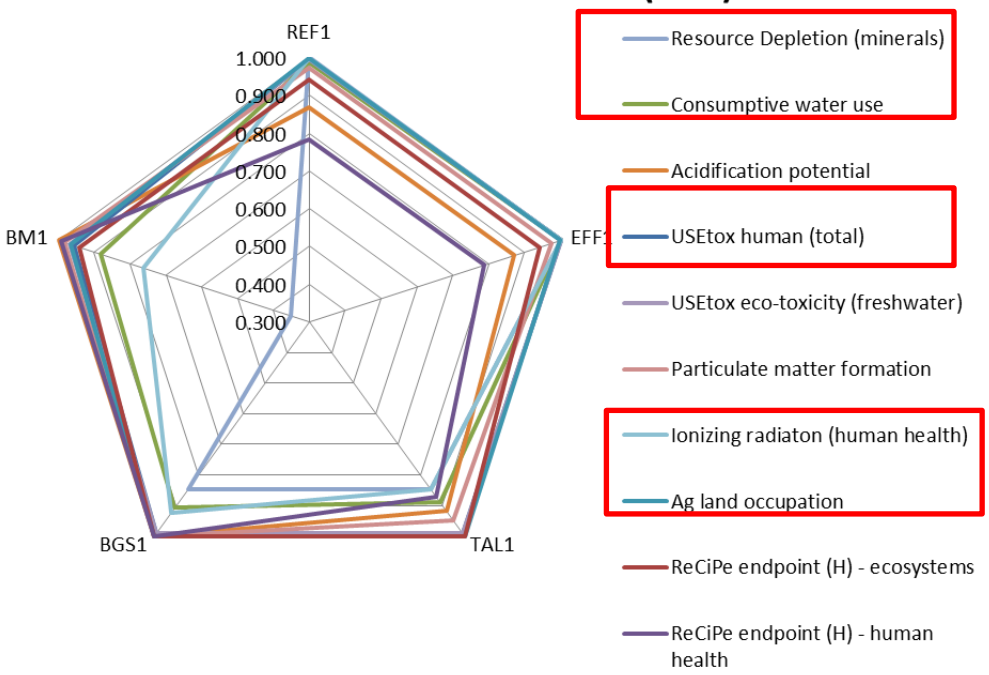


# 5. Modelling results - tallow

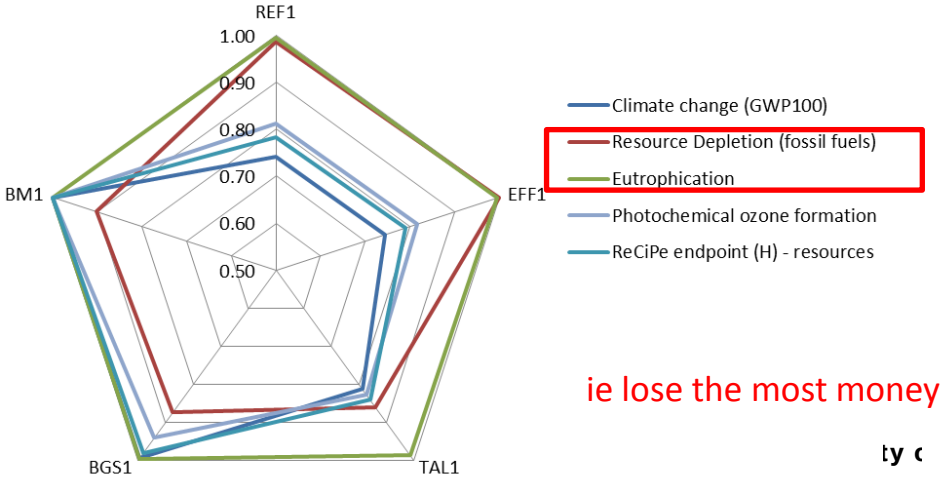
## Tallow - sink (TAL)




## Tallow - sink (BGS)




## Tallow - sink (BM)

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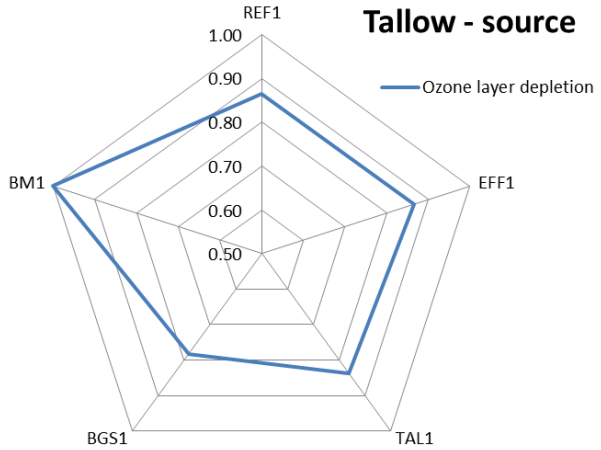
## Tallow - source

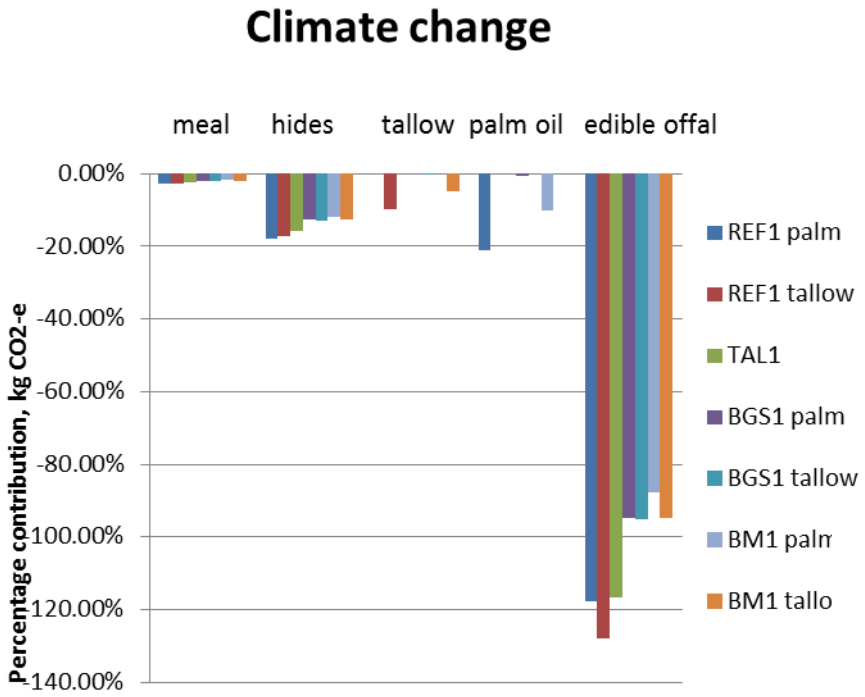


# 5. Modelling results

- Tallow option is the worst
- Not much difference in many categories between biogas and biomass options

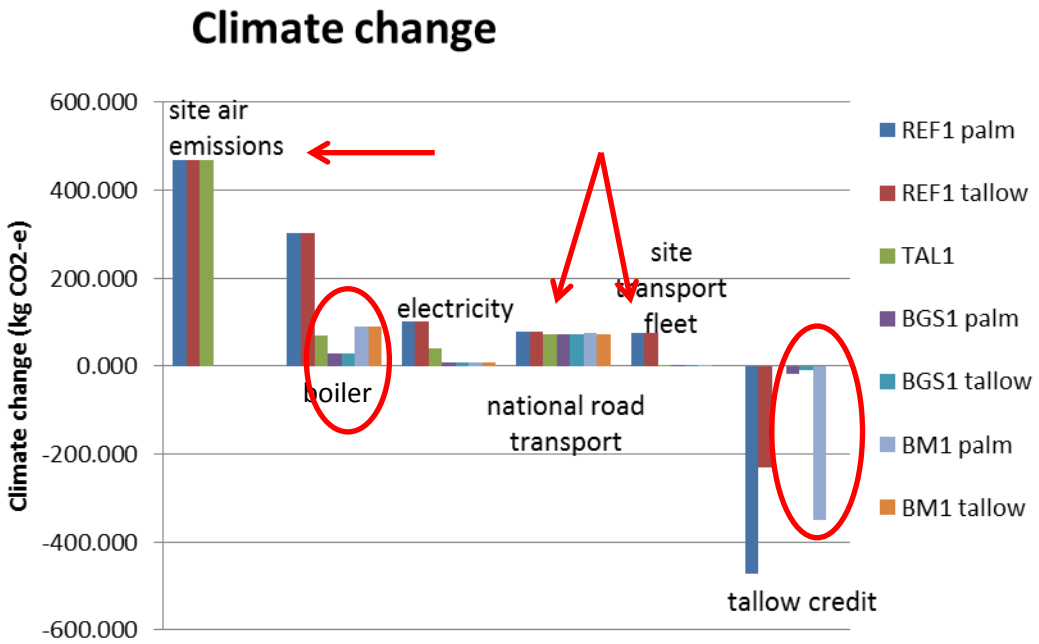
… but which processes are contributing to the results?

# 5. Process contributions




← With system expansion for coproducts

Without system expansion for coproducts that remain the same between cases →



# 5. Interpretation of process contributions

- Importance of ↑ yield/sales + ↓ losses of
  - Edible offal
  - Hides
- Importance of managing
  - Methane from ponds
  - Transport emissions → sell tallow biodiesel to suppliers?
  - Emissions from thermal energy – trade off with credit
- Palm oil has higher emissions than tallow per unit → importance of reference product system

# 6. Discussion & Conclusion

- Additional cases
  - Domestic market – canola instead of palm/tallow
  - Larger solar PV
  - Cogeneration
- Future research
  - financial cases
  - Integrating supply chains like Sweden (beef + dairy)