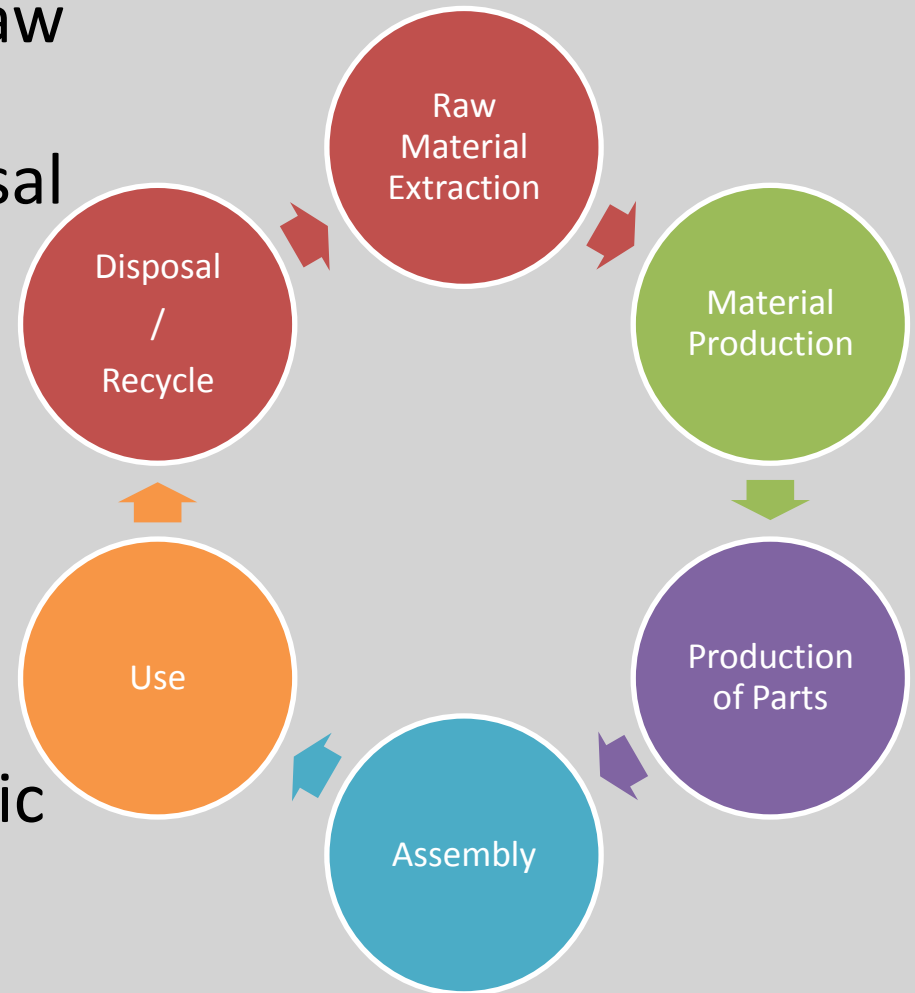


# Life Cycle Assessment of a 100% Australian-Cotton T-Shirt

Institute for Sustainable Resources  
Queensland University of Technology  
2009

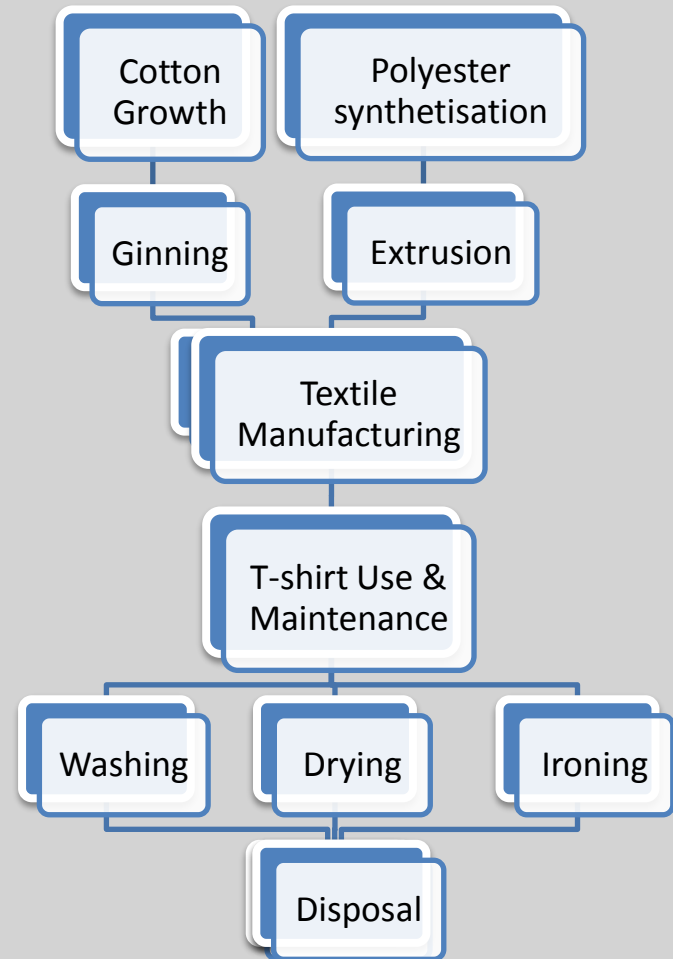
# Life Cycle Assessment

- Includes production of raw materials, product assembly, use and disposal
- Includes environmental impact from producing inputs (petrol, buildings, fertilisers, etc)
- Identifies environmental hotspots
- Quantitative and scientific basis



# The Study

- Main Focus:
  - GHG emissions
  - Fossil fuel depletion
- Goals:
  - Market communication
  - Identify GHG reduction possibilities in the production and manufacturing chain



# Environmental Categories

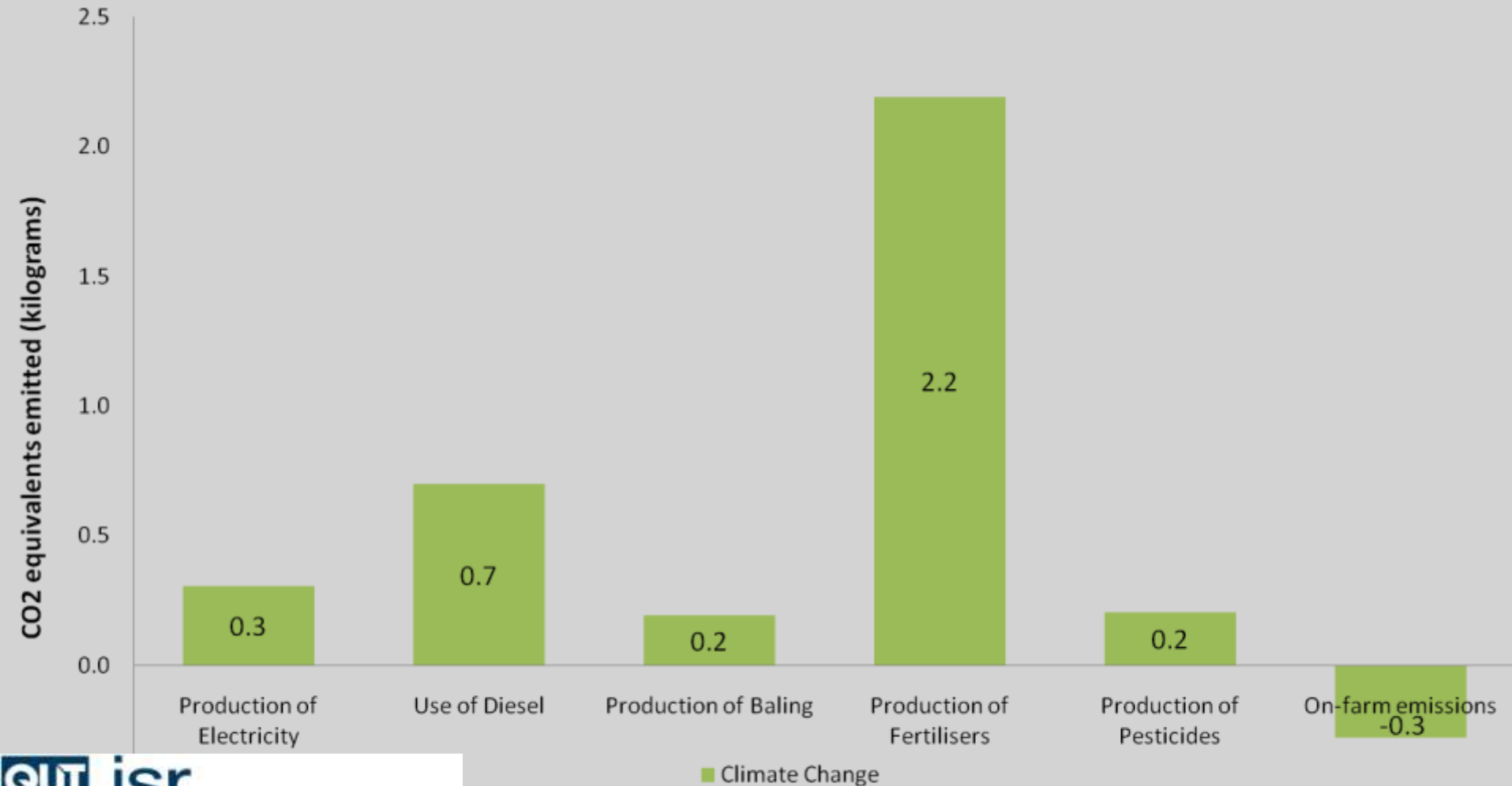
- Climate Change -> Direct GHG emissions
  - Soil N<sub>2</sub>O emissions
  - Cattle CH<sub>4</sub> emissions (if applicable)
  - Plant and soil decomposition (CO<sub>2</sub>)
- Fossil Fuel Depletion
  - Burning of fuel for machinery (production and manufacturing)
  - Burning of coal to produce electricity
  - Use of crude oil as input material (fertilisers, polyester)

# Other Environmental Categories

- Ozone Layer Depletion
  - Emission of CFCs or other ozone depleting substances
- Mineral Resources Depletion
  - Depletion of phosphorus
  - Depletion of uranium

# Cotton Production Carbon Footprint

- Carbon Footprint: 3.3 kg CO<sub>2</sub>e/kg cotton



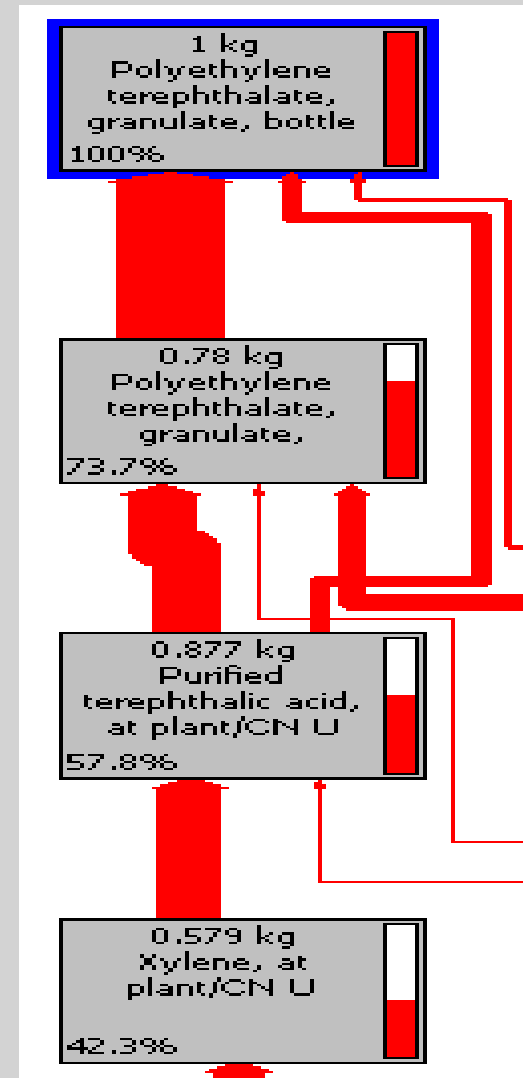
# On-Farm GHG Emissions

- Assume Standard N fertiliser 200 kg N/ha  
+ 0.101 kg CO<sub>2</sub>e/kg cotton
- On-farm use of fuel  
+ 0.15 kg CO<sub>2</sub>e/kg cotton
- Cotton plant absorbs CO<sub>2</sub>  
- 0.567 kg CO<sub>2</sub>e/kg cotton

Net On-farm Emissions are **-0.279** kg CO<sub>2</sub>e/kg cotton

# Polyester Production

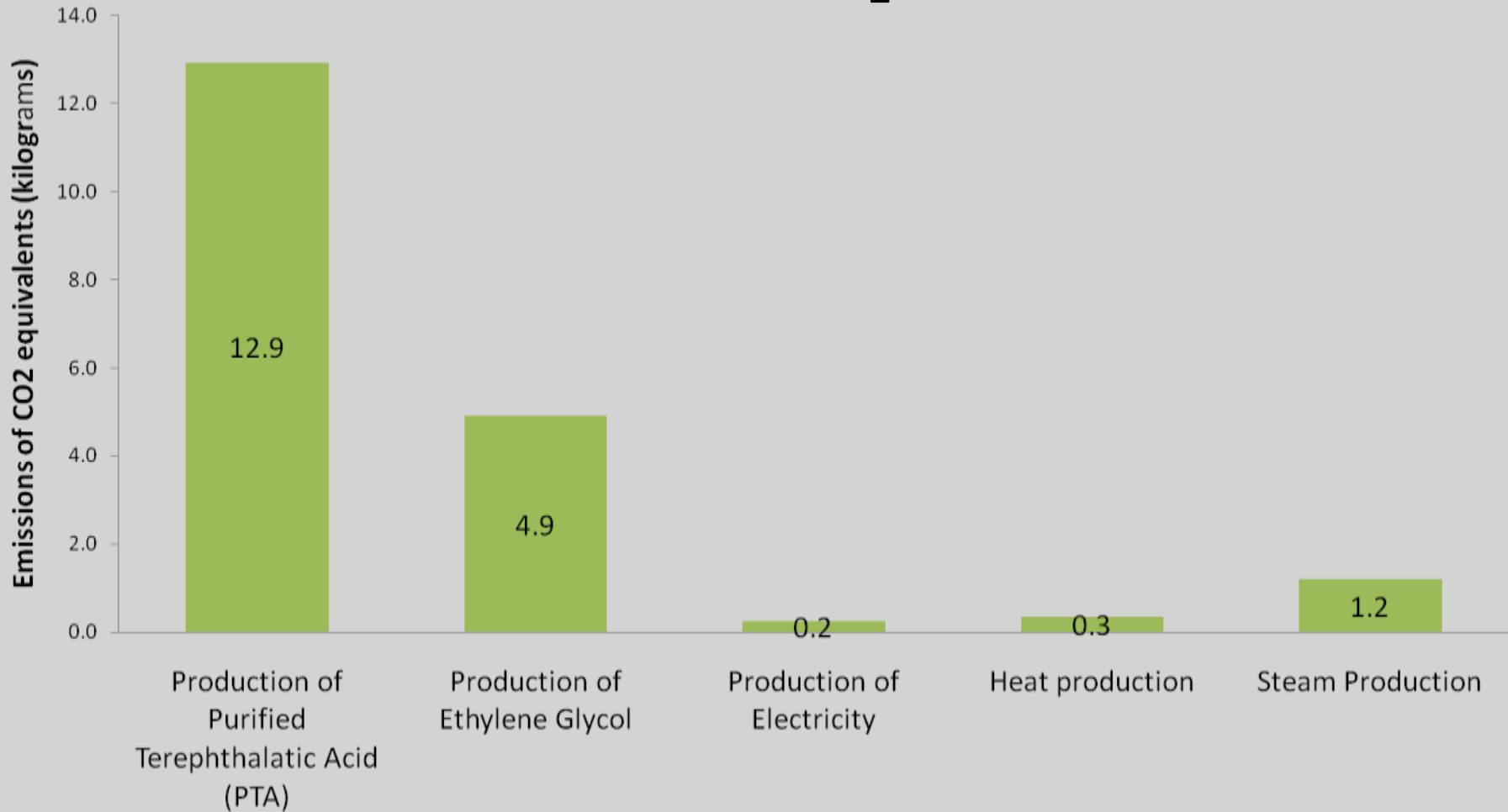
- Why is polyester worse for the environment?
  - Synthetisation requires significant amounts of energy
  - Based on Xylene -> Crude Oil
  - Oil extraction and export very energy-demanding and contaminating





# Polyester Carbon Footprint

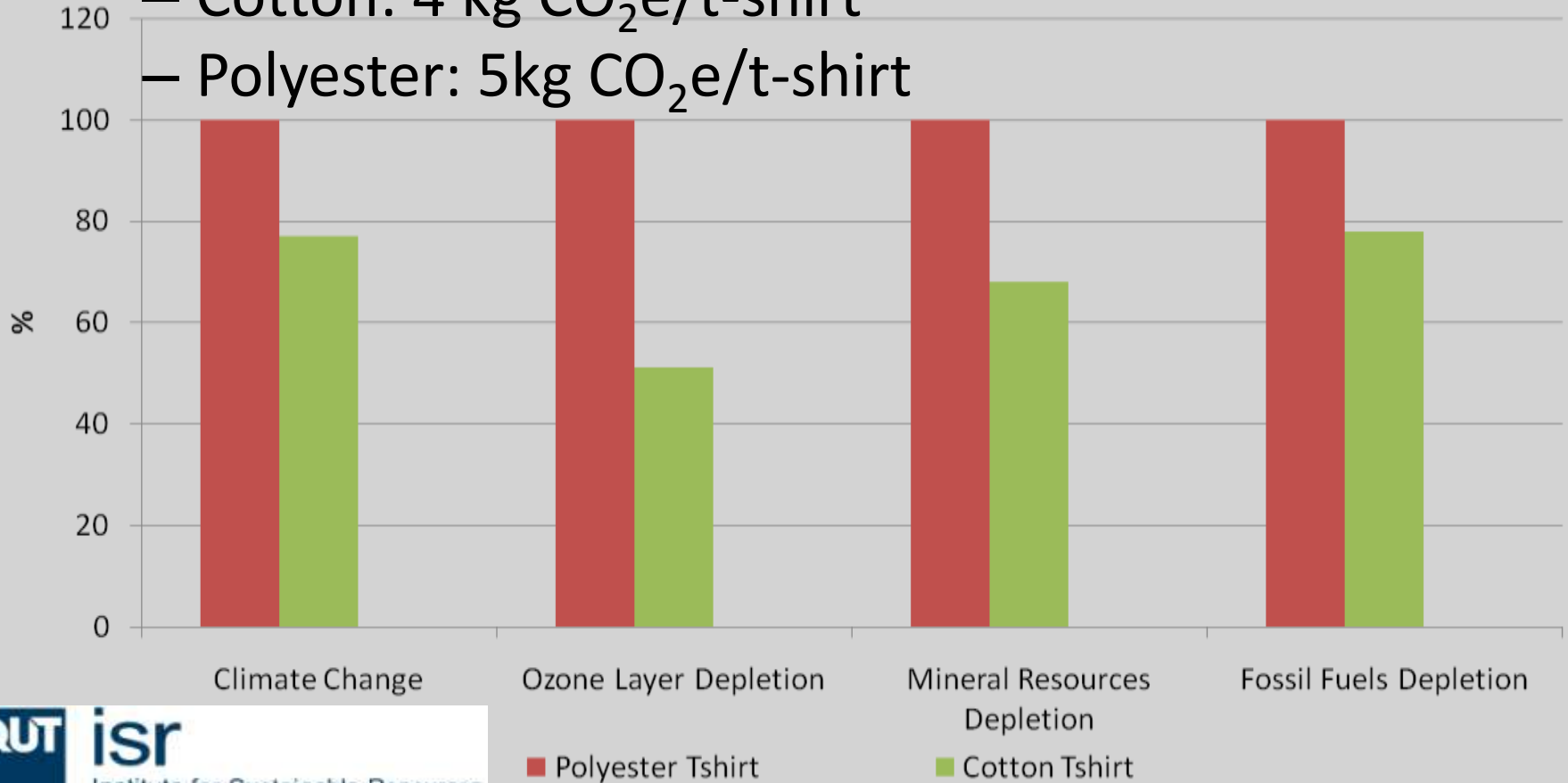
- Carbon Footprint: 20 kg CO<sub>2</sub>e/kg polyester



■ Climate Change

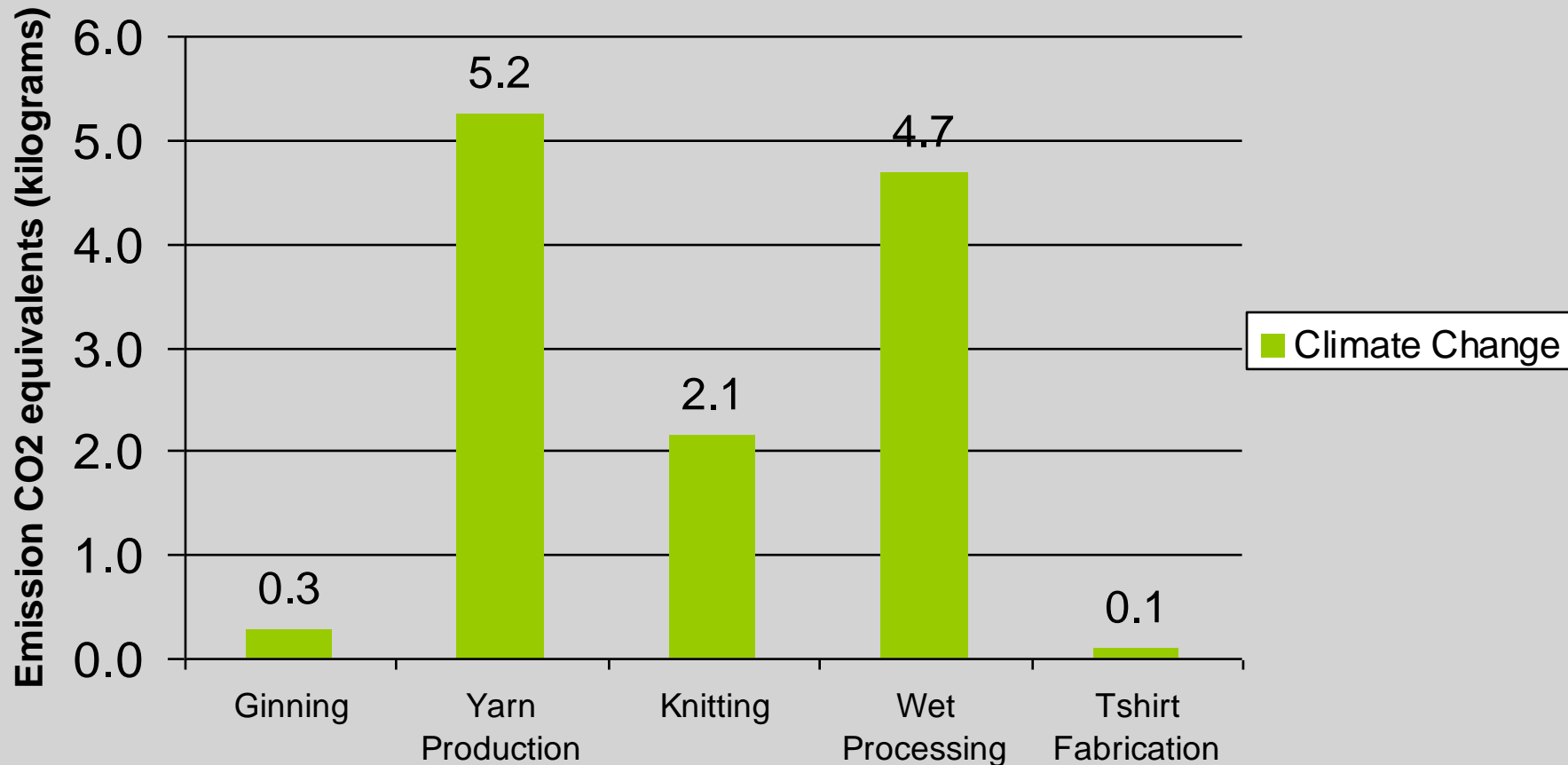
# Cotton vs. Polyester

- Overall, cotton is better for the environment than polyester
- Estimated GHG emissions from production:
  - Cotton: 4 kg CO<sub>2</sub>e/t-shirt
  - Polyester: 5kg CO<sub>2</sub>e/t-shirt



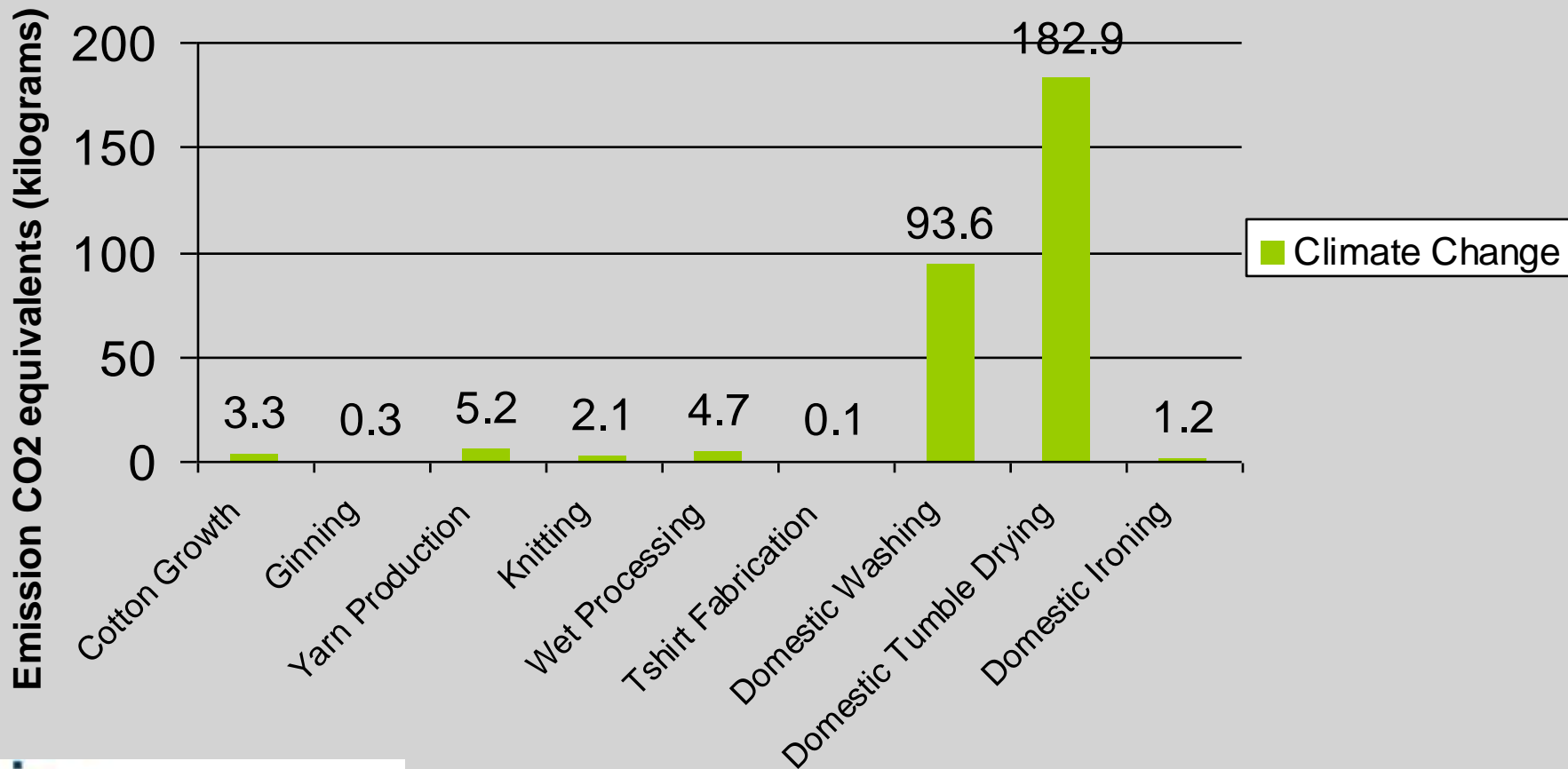
# The Textile Manufacturing Phase

- Contributes 12.5 kg CO<sub>2</sub>e/kg textile



# The Use Phase

- Dominates the Life Cycle -> 75 wash-dry operations
  - 96% of whole of life-cycle impact (277 kg CO<sub>2</sub>e/t-shirt)

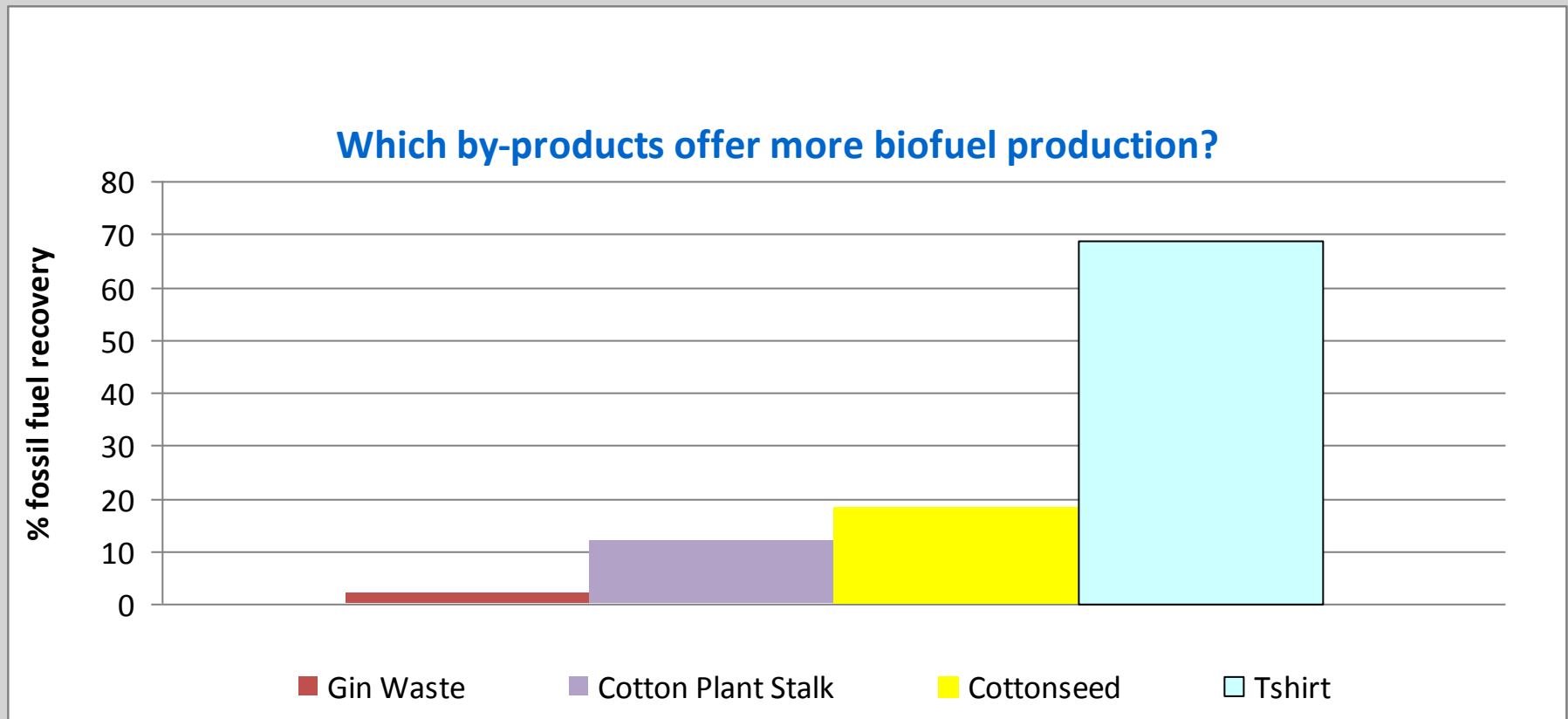


# Reliability of Results

- High reliability
  - Specific and accurate sources
  - Use of reliable LCA databases
- Need to understand the goal of the study
  - Not about how much better cotton is  
but about which product is clearly better
  - Figures of GHG emissions are approximate

# How to make cotton production greener

- Improve fertiliser efficiency and management
- Reduce diesel consumption



# Future Research

- Improve accuracy
- Assess other environmental categories
  - Water use (water depletion, water contamination...)
  - Land use (biodiversity, soil salinisation...)
- GHG reduction options
- How to maximise environmental benefits from cotton by-products