VOLTA: from CO_2 to plastics with negative C-footprint

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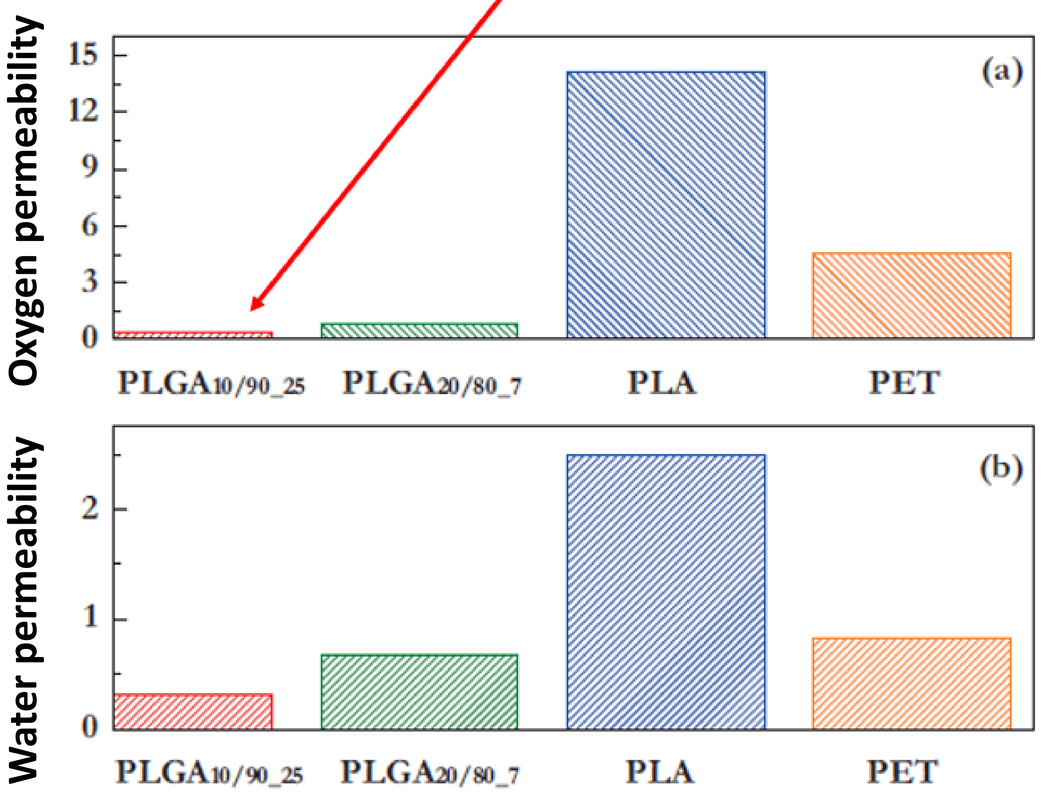
Motivation

Avantium is working on various alternative feedstock options for producing **future plastics**. Next to glucose (for FDCA/PEF), also CO_2 can be used as carbon source for making plastics. **Not** all products from CO_2 require large energy investment. We focus on **monomers that will be winning** when starting from CO_2. Winning = lowest cost and superior performance. When we use **CO_2 form the air** or **bio- CO_2** (from fermentation, biomass electricity or waste incineration) and when using renewable energy, products with a negative carbon footprint can be obtained.

Defined	• CO_2 is well defined vs biomass feed stock
Agnostic	• Multiple sources are possible- Biogenic and DAC are preferred for the long term
Competitive	• No competition with food/land use/deforestation
Clean	• Electrons as a reagent; very high selectivity
Flexible	• Technology allows "peak-shaving"
Valuable	• One of the few technologies to turn CO_2 into valuable products with the potential to enable carbon negative materials
De-risked	• Scaling out electrochemical cell stacks dramatically reduces the risk of scale-up
Potential	• Ability to address large markets (proteins, ethanol, chemicals, polymers and fuels)

Oxygen barrier PLGA 10/90
- 150x better than PLA
- 50x better than PET;
- 5x better than PEF



Oxygen (a) and water (b) permeability for 2 PLGA's
Measured at 30°C and 70% RH. (g.mm/m².day.bar)

Value Proposition

- CO_2-based → potentially carbon negative footprint
- Good mechanical properties (semi-crystalline)
- Excellent barrier
- Closed-loop recyclable
- Home compostable; marine degradable

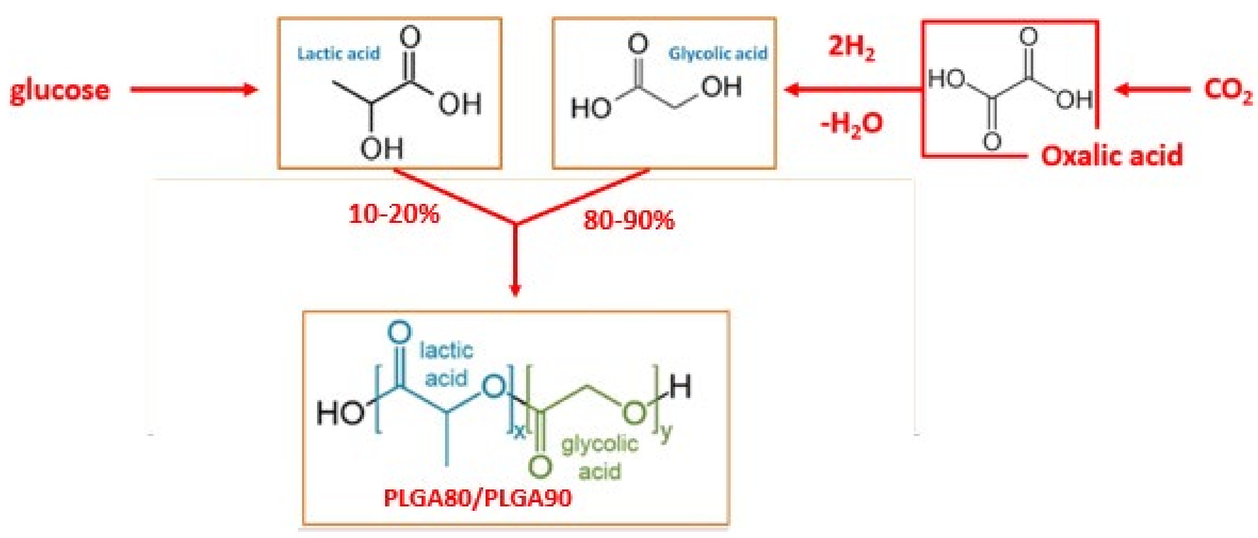
Aims

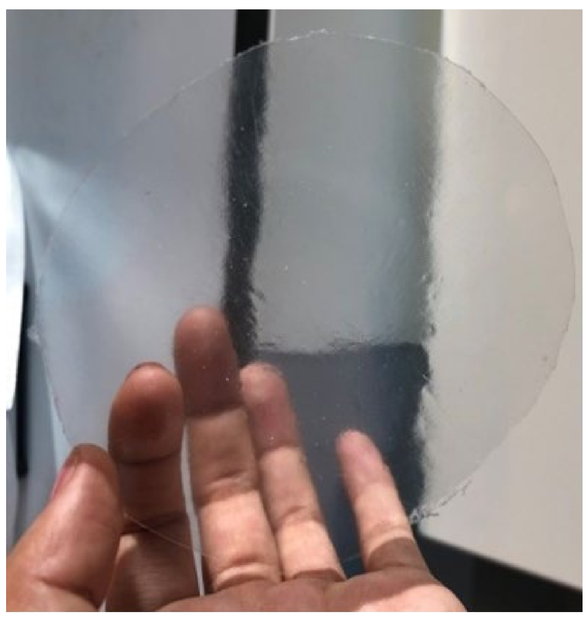
Produce High performance polymers/plastics from CO_2 as carbon source. PLGA is strong, has fantastic gas-barrier, is closed-loop recyclable, is home compostable and marine degradable.

Approach

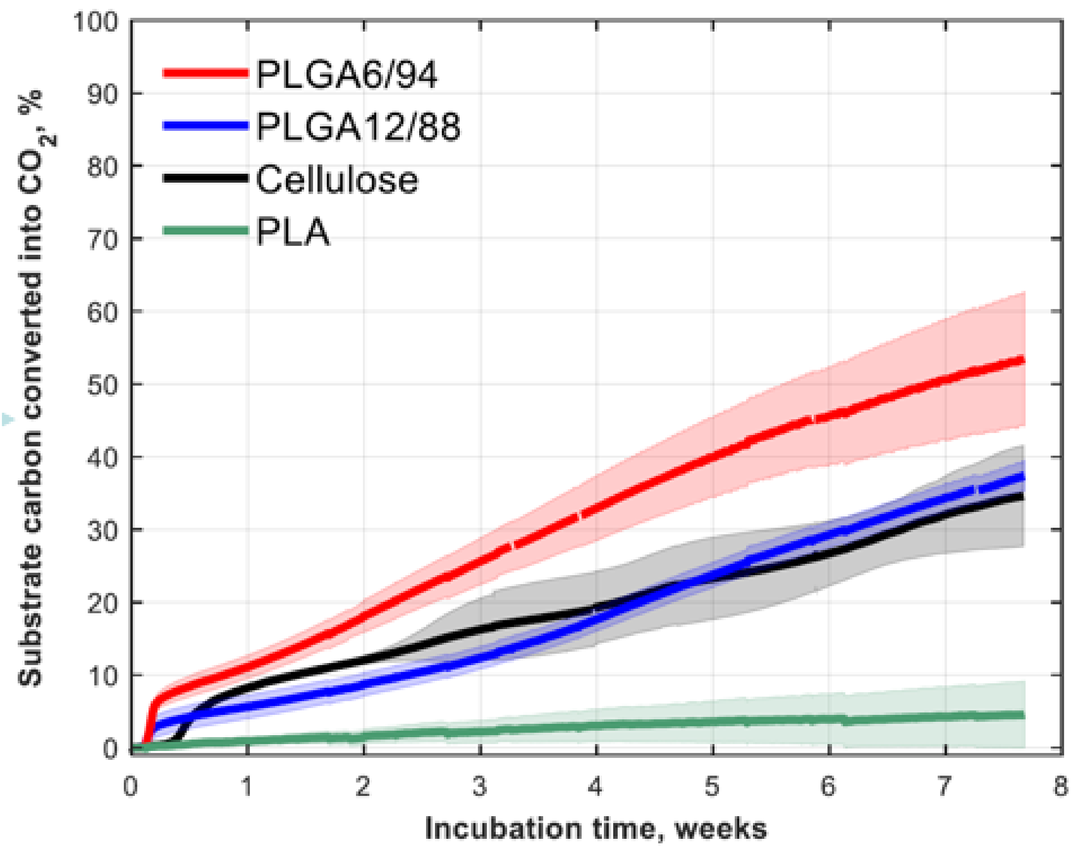
Three business cases:

1. **2 CO_2 → HOOC-COOH (oxalic acid); ~4 MWh electricity/ton**
2. **HOOC-COOH (oxalic acid) + 2H_2 → HOOC-CH_2OH (glycolic acid)**
3. **Glycolic acid → polyglycolic acid (PLGA)**





PLGA biodegradation:



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