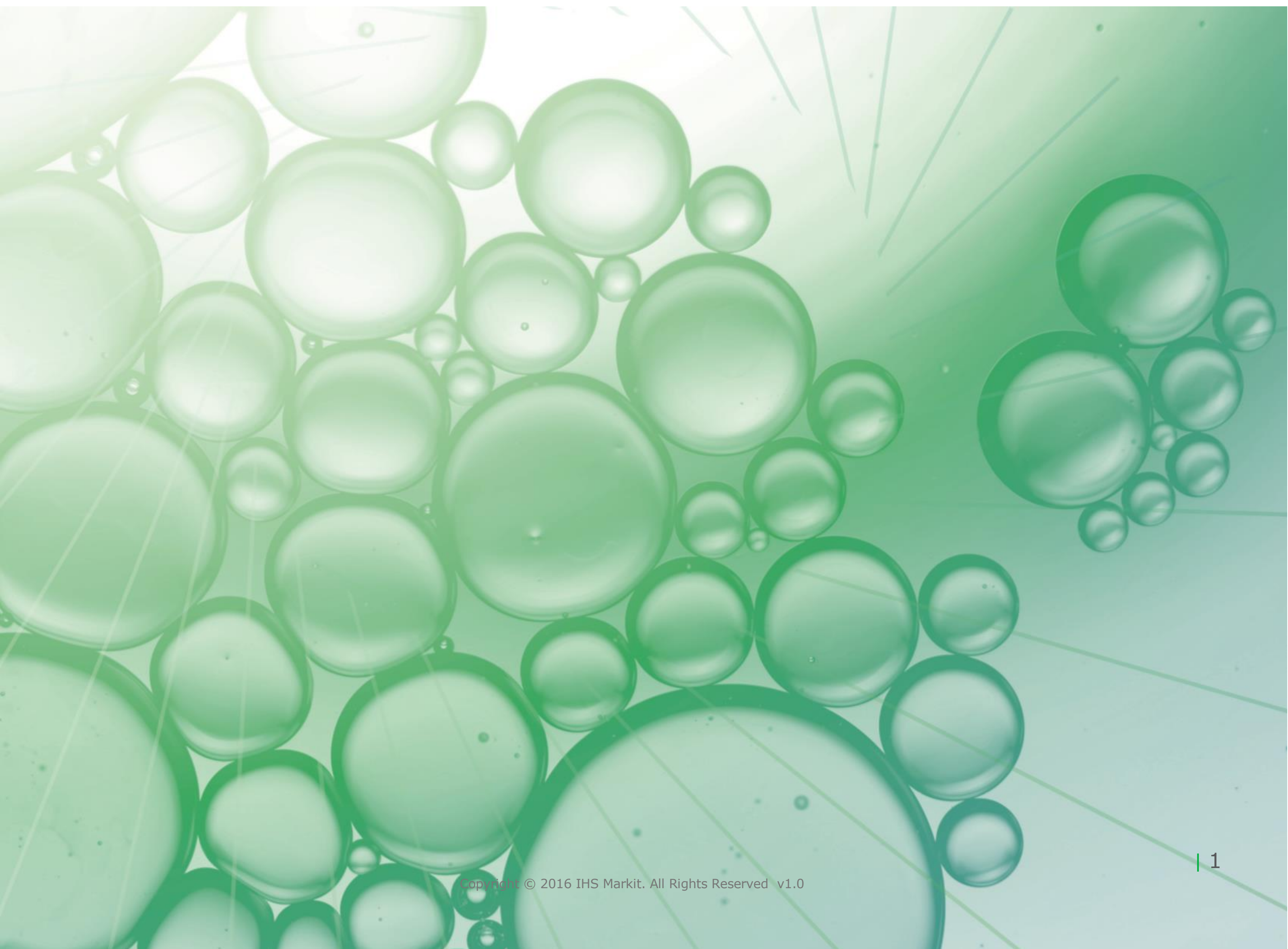
Case Study

Process Economics Program (PEP)

How PEP helps: Linear Alpha Olefins (LAO)



Case Study & Background

Global Linear Alpha Olefins (LAO) Global LAO capacity is estimated to increase by almost 50% between 2012 and 2018. A key driver to this growth is their use as copolymers (e.g., hexene 1 and octene-1) in polyethylene. About 70% of global LAO capacity is produced using broadly active catalytic systems that produce a wide range of carbon number LAO (e.g, C4-C20+. More recently developed On-purpose processes avoid cumbersome downstream separations for applications that require just one olefin.

Scenario

There are a great many LAO processes, past, present, and emerging.

Wide range LAO		Feedstock	98% of LAO product
ChevronPhillips Chem.	High temperature process	Ethylene	C4 – C28
Shell	SHOP	Ethylene	C4 – C20+
Idemitsu	Linealene	Ethylene	C4 – C20+
DuPont	Versipol	Ethylene	C4 – C20+
UOP	Linear-1	Ethylene	C4 – C18
Intermediate range LAO			
INEOS	Total butene recycle	Ethylene	C6 – C14
IFPN/Axens	AlphaSelect	Ethylene	C4 – C12+
SABIC & Linde	alpha-SABLIN	Ethylene	C4 – C12+
Narrow range, on-purpose LAO			
Sasol	F–T extraction	CTL streams	n-C5 and n-C6
Sasol	Tetramerization	Ethylene	n-C8 and n-C6
ChevronPhillips	Trimerization	Ethylene	n-C6
IFPN/Axens	AlphaHexol	Ethylene	n-C6
Lummus/CBI	CPT Metathesis	Mixed C4	n-C6, C2, C3
IFPN/Axens	AlphaButol	Ethylene	n-C4
UOP & UCC	Raffinate-1 adsorption	Mixed C4	n-C4
Open	Raffinate-1 adsorption	Mixed C4	n-C4 and iso-C4
Open	Raffinate-2 distillation	Mixed C4	n-C4
Open	Partial hydrogenation	Butadiene	n-C4

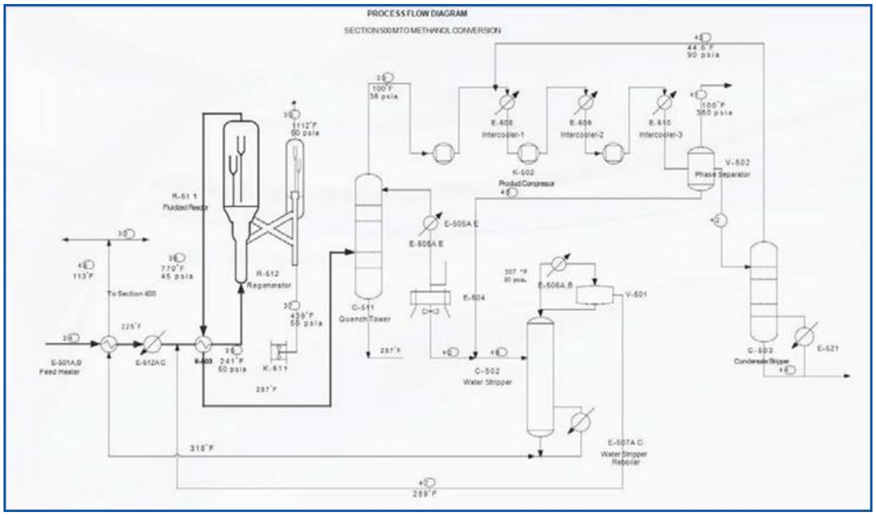
Issue

The selection of a technology is complex as each has a unique design, set of operating parameters, and pros and cons depending on user needs.   As such, the selection of a specific technology. Available LAO technology selection includes over 10 technologies practiced commercially, each with advantages and disadvantages over a spectrum of attributes including:

- Product type and quality
- Feedstock type
- Process configuration
- Scale
- Energy efficiency
- Carbon efficiency and footprint
- Raw materials, utilities, and fixed costs
- Commercial experience

Approach

We have a proven methodology for providing our customers a side-by-side technology and economics comparisons of the various process types by bringing all on a common basis and in a single point in time. A detailed technical and economic engineering analysis of each process is provided in our PEP report, to allow a full assessment of advantages and disadvantages.



Results

For multiproduct plants such linear alpha-olefins, the evaluation shows that the stake holders' preference of a: full-range or on-purpose requirement, co-product integration, geographic location and/or carbon footprint set the relative advantages of each technology. For LAOS the choice of technology will be dependent of which balance of attributes are of most importance to a producer. For example, the capital investment (per ton product) varies greatly among the different processes, as do consumption of energy and CO2 emissions.