AVIATION CO_2 REDUCTIONS

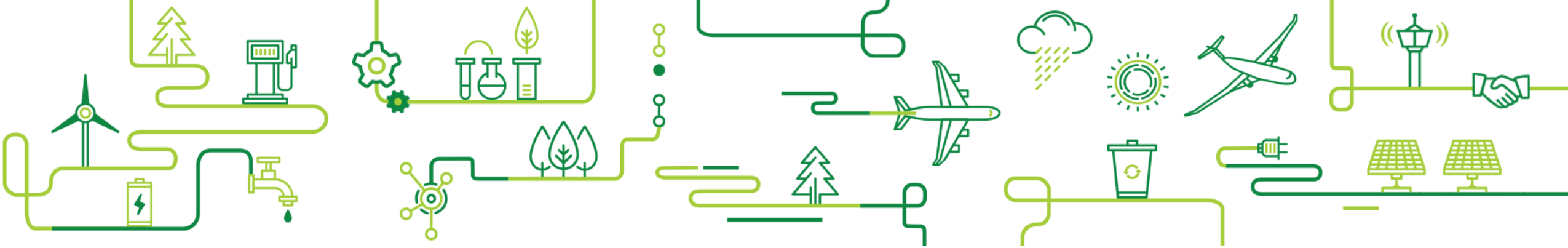
STOCKTAKING SEMINAR

TECHNOLOGY · OPERATIONS · SUSTAINABLE AVIATION FUELS

Sustainable Aviation Fuels (SAF) – Introduction and Frequently Asked Questions

Jim Herbertson

Technical Director, Climate and Energy – IPIECA



Why Low Carbon Aviation Fuels (LCAF)?

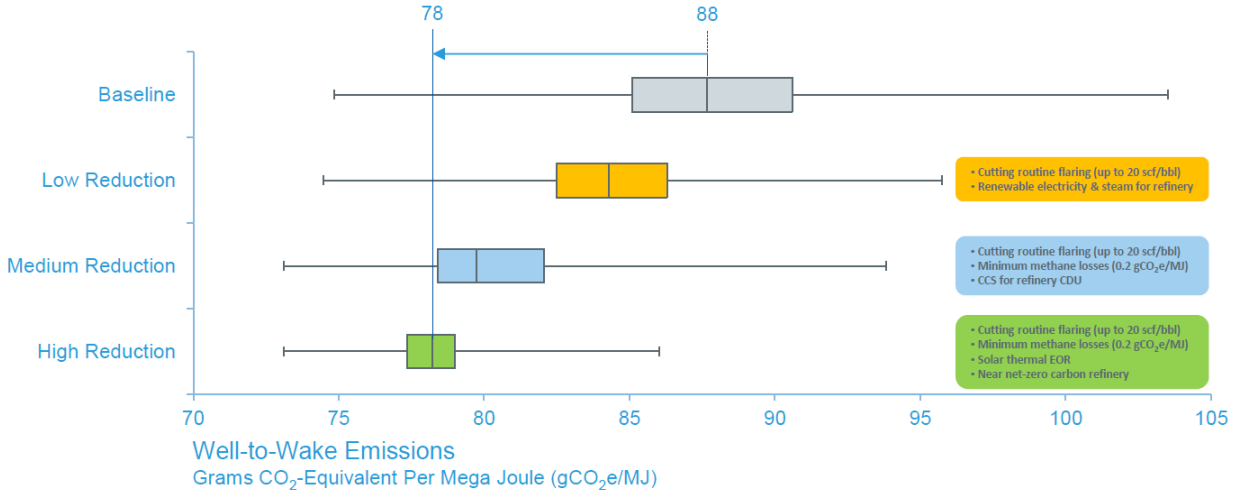
- LCAF is a fossil-based aviation fuel that meets CORSIA Sustainability Criteria
  - Net greenhouse gas emissions of at least 10% lower compared to the baseline life cycle emissions values for aviation fuel on a life cycle basis

- LCAF can contribute GHG reductions that are complementary to the GHG reductions from SAF in lowering overall aviation fuel carbon intensity
  - Both LCAF and SAF would be CORSIA eligible fuels and, as such, used by an operator to reduce its offsetting requirements under CORSIA

Options for making Low Carbon Aviation Fuels (LCAF)

- Lower the carbon intensity from hydrocarbon production and from refining and distribution of petroleum-based aviation fuels
- Techniques to reduce the baseline LCA emissions value for aviation fuel from 89 gCO_2e/MJ include:
  - Enhanced energy efficiency
  - Reduction of routine flaring
  - Minimizing methane emissions
  - Incorporating renewable electricity and steam into refinery operations
  - Application of Carbon Capture and Storage
- Implementation of LCAF rewards improved operational practices with a clear incentive for lowering carbon intensity production

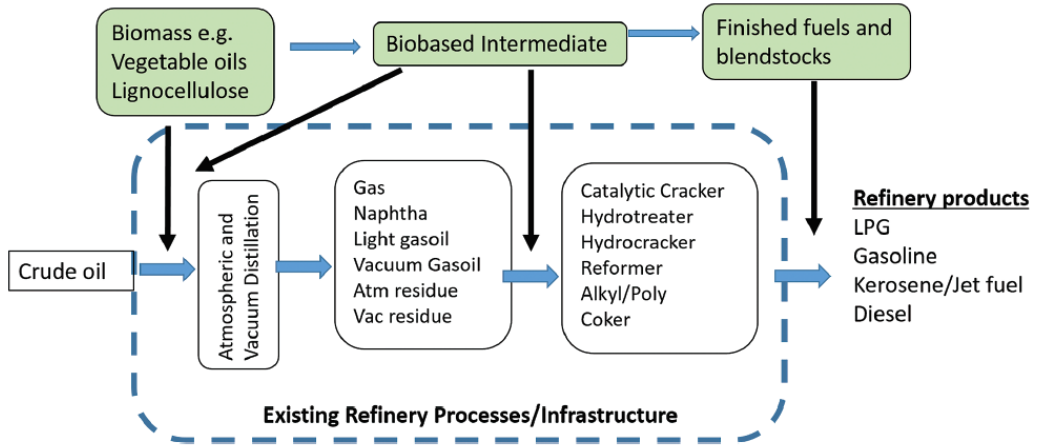
Aviation Fuel GHG Emissions Reduction



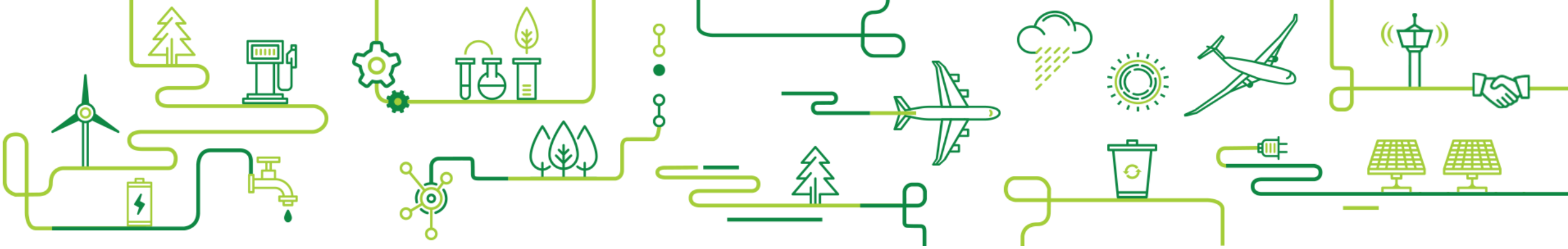
Source: J-C Monfort and H.M. El-Houjeiri, Aramco Services Company (2019

Co-processing may be an option to reduce CO_2 intensity for traditional aviation fuels

- Molecules from a range of biological origins can be commingled and treated in a refinery to produce lower carbon intensity finished products
- ASTM D1655 recognizes that co-processing of mono-, di- and triglycerides, free fatty acids, and fatty acid esters producing co-hydroprocessed hydrocarbon synthetic kerosene as being acceptable for manufacture of aviation fuel
- Co-processing brings certain advantages:
  - GHG reductions are material and near-term
  - No change to fuel distribution system, consumer behaviour, or customer-facing infrastructure
  - No new engine design or fleet requirements
  - New feedstocks can be brought on stream as available

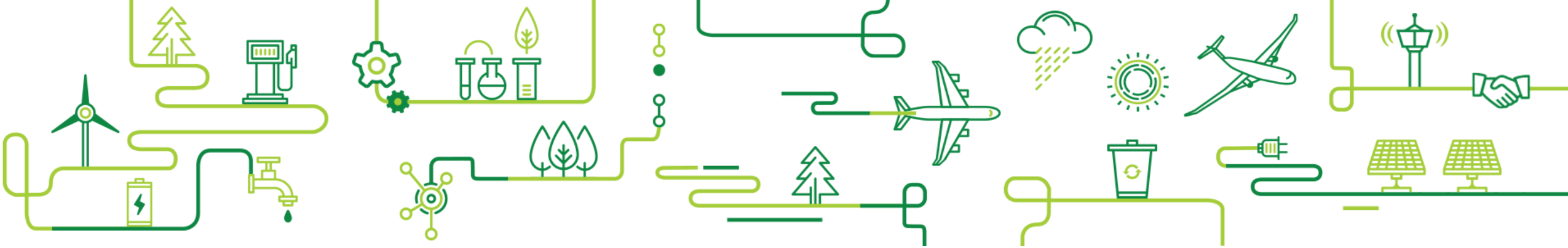


Source: Van Dyk et aL. Potential synergies of drop-in biofuel production with further co-processing at oil refineries



What are the challenges for LCAF?

- Better stakeholder understanding of scale of aviation fuels industry and contribution LCAF can make alongside SAF
- Development of detailed LCA methodologies for the consideration of lower carbon aviation fuel (LCAF) under CORSIA
- Understanding and mitigating any potential impacts to existing infrastructure
- Ensuring product quality throughout the supply chain



Next Steps in cooperation and collaboration

- IPIECA members have significant technical expertise along the fuel supply chain with both conventional hydrocarbon and renewable fuels and a long history of extensive collaborations with regulators and OEMs around the world on product quality specifications
- IPIECA looks forward to engaging more fully with ICAO in the technical work involving Lower Carbon Aviation Fuels