MSP: Renewable Feedstock Availability for 2050

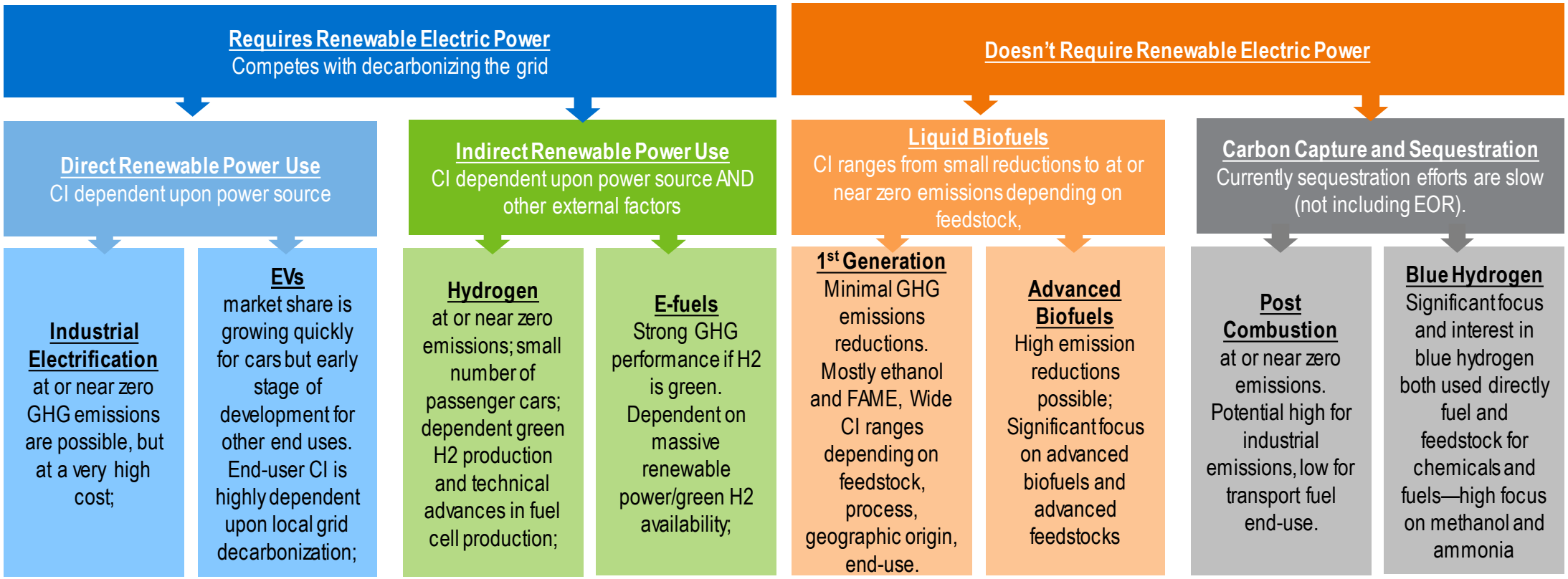
A Multi-Volume Market Scenario Planning Report

NexantECA

September 2023

The transition from fossil to low/zero carbon mobility will require both electrification and alternative liquid fuels at great scale –there isn't enough renewable power to get us to net zero 2050 with power alone

The decarbonization of the transport industry involves the elimination of GHG emissions from – at present – 850 million cars, 440 million commercial vehicles, 140 million two-wheelers, 35,000 commercial jet aircraft and over 50 thousand merchant marine vessels; while a range of options are feasible for this massive task, many of them require vast quantities of cheap, sustainable, low CI power, which is also required to decarbonize existing power production:



Biofuels aren't perfect but are the lowest hanging fruit for decarbonization of the transport sector

Biofuels are produced from a multiplicity of organic feedstocks; these drive economics, sustainability, Carbon Intensity and – crucially – levels of regulatory support

There are three main groups of biofeedstocks, each relevant to different downstream products:

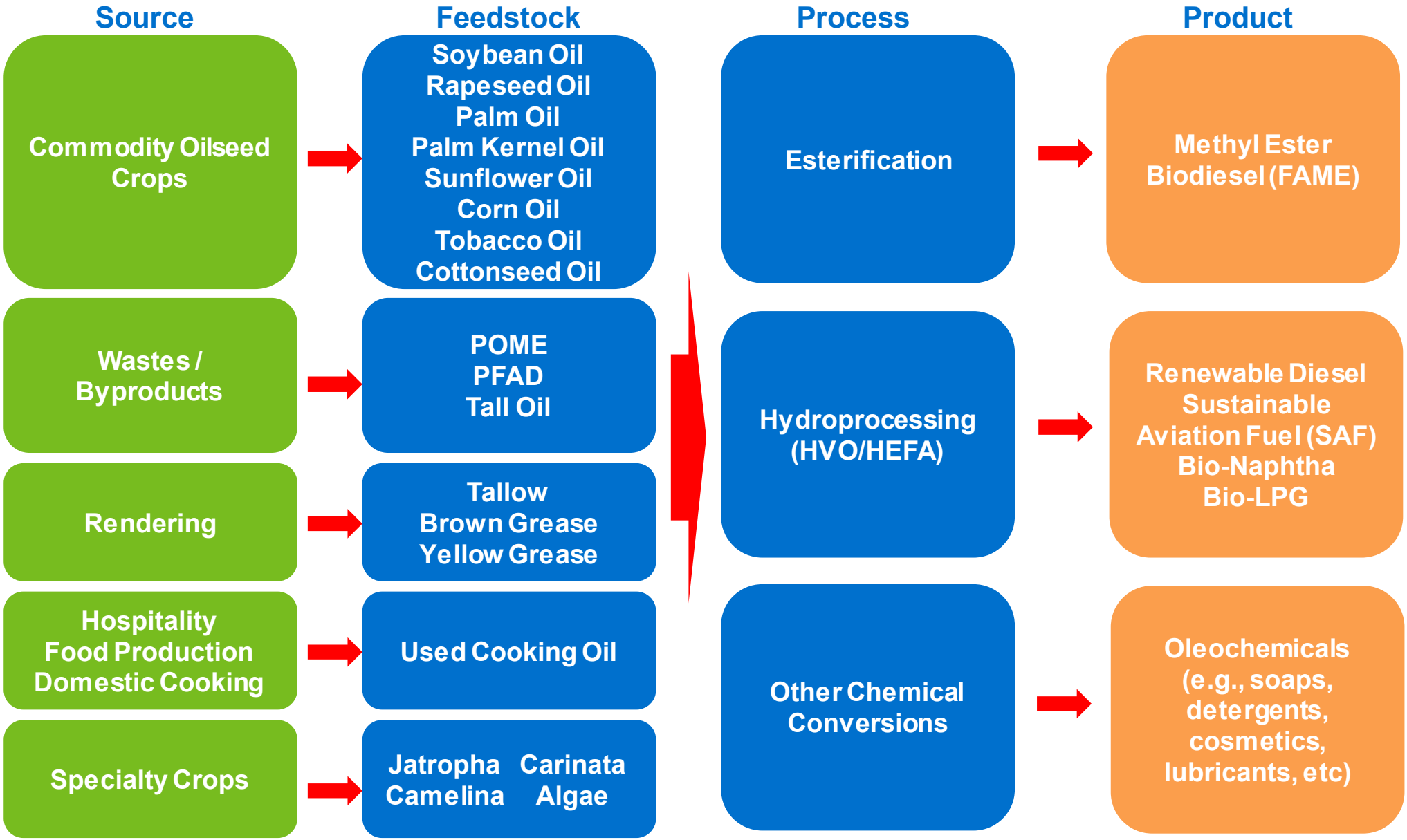
Natural Oils	Starch / Sugar / Carbohydrates	Emerging Feedstocks
Used mainly in the production of FAME biodiesel or newer "drop-in" fuels (e.g., SAF, RD)	Used mainly for fermentation to "first generation" ethanol production	Currently led by cellulosics, but also including less certain options such as algae cultivation

The availability and sustainability of these feedstock groups is a key factor in the historic and future evolution of the global biofuels market; the choice and geographic origin of different feedstocks plays a major role in biofuel cost, scale, and emissions reduction potential

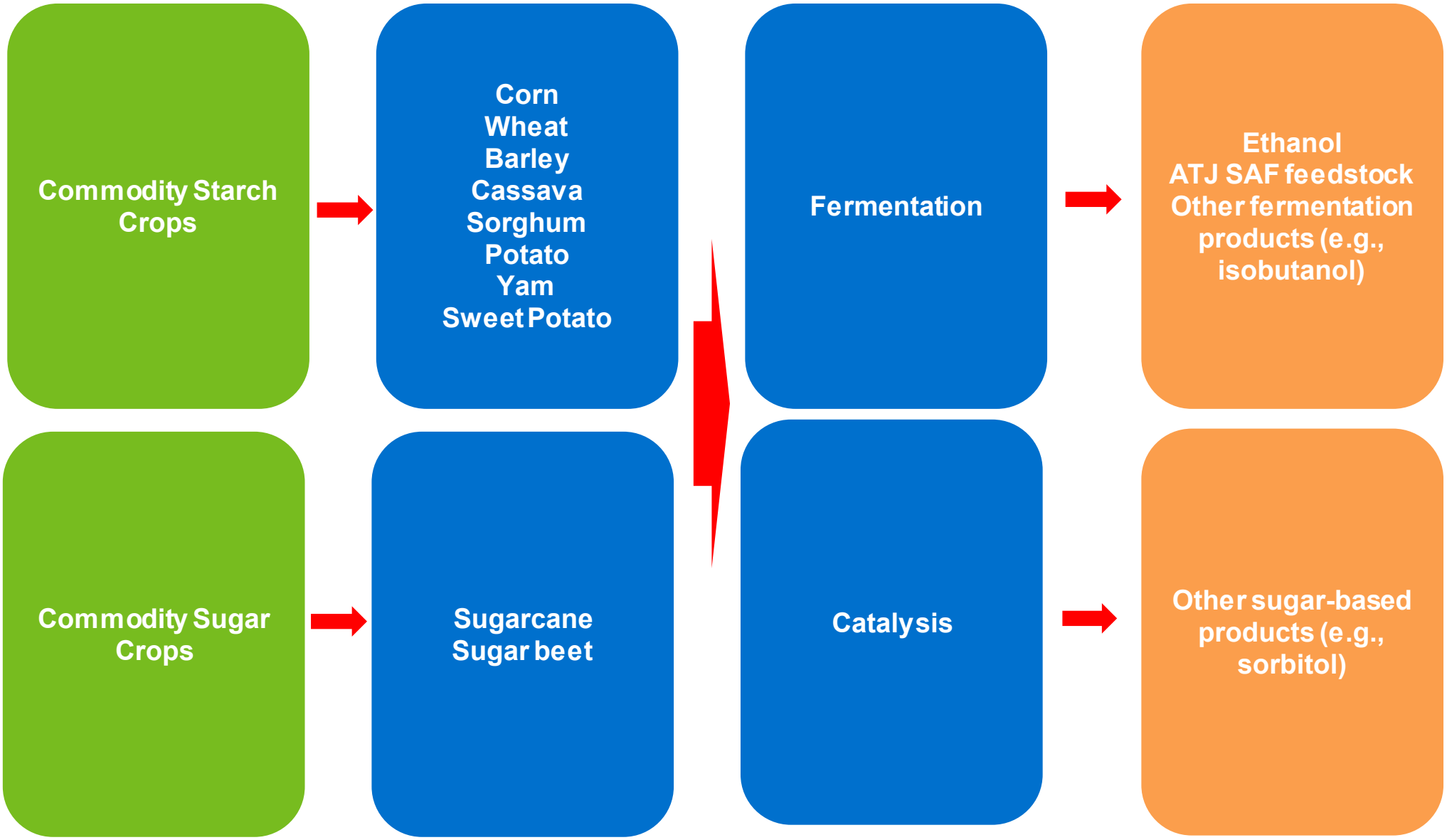
- **Scale impact:** Overall cultivation of feedstocks is dependent on land use, and sets a ceiling on production
- **Price impact:** The volatile nature of agricultural pricing impacts cost of production and profitability, with multiple factors external to biofuel consumption trends driving feedstock prices
- **Sustainability/GHG impact:** Different approaches to feedstock production (agricultural, waste-related, etc.) translate to widely varying life cycle emissions reduction potential for different biofuels, from carbon negative to higher than petroleum equivalents
- **Regulatory impact:** Driven by the above and central to biofuels growth, regulatory incentives and disincentives on particular feedstocks will – and has in the past – either open up or close down entire markets.

A mix of biofuels and biofeedstocks will be required to even attempt to meet net zero goals

Natural oil feedstocks are used mainly in FAME biodiesel and "drop-in" fuels production, and extensively in oleochemicals



Sugar / starch / carbohydrate feedstocks are mainly for fuel ethanol use, but will play into SAF and other sugar-based products for the chemical industry to a lesser extent



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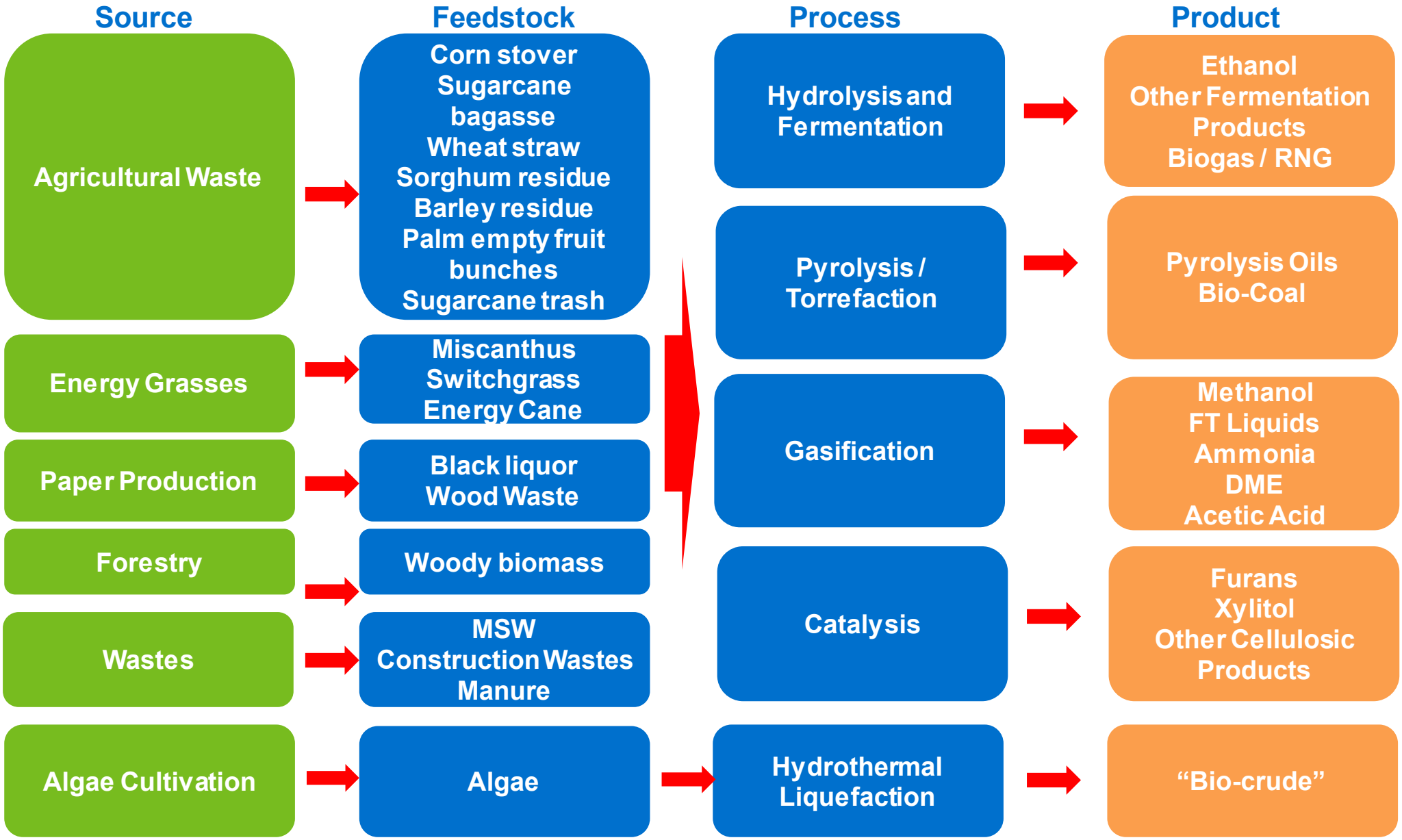
Most emerging feedstocks are cellulosic material; algae to multiple products may emerge in the longer-term



NexantECA is producing a series of Market Scenario Planning reports outlining historic and potential feedstock availability for biofuels across the board and around the world

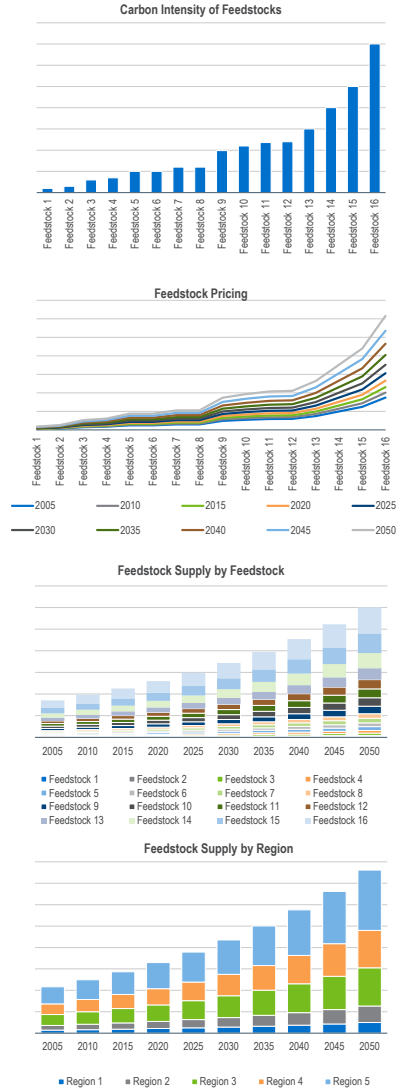
For each main natural oil, carbohydrate and emerging biomass feedstock, NexantECA will present:

- Discussion of key market drivers and competing end-uses
- Historic production by region
- Historic pricing behaviour
- Sustainability profile, including carbon intensity
- Historic and forecast production of relevant biofuel by region
- Business as usual, base, and aggressive adoption scenarios for production from 2024 to 2050

NexantECA will answer the following questions:

- Will sufficient feedstocks be available to support currently targeted biofuels market growth without leading to significant constraints on other uses?
- How sustainable is each feedstock? How much of the most sustainable feedstocks may be available? Which are supply constrained?
- How will price developments in other sectors impact the cost of biofuels production?
- What is the outlook for feedstock competition between different key biofuels (for example, FAME biodiesel and Sustainable Aviation Fuel from Used Cooking Oil)?

Example Output Graphics (Illustrative Only)



The report volumes will be delivered in MS PowerPoint with MS Excel format supporting files

Planned Table of Contents: Volume 1: Macro Analysis / Executive Summary

The Macro Analysis will function as an Executive Summary and summarize findings from the various volumes, and compare findings by both feedstock and regions. It will draw macro conclusions based upon the individual analyses and conclusions found in the other volumes.

The Macro Analysis will only be available if subscribed to all other volumes of the report.

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Planned Table of Contents: Volume 2: Natural Oils Feedstocks

Each section in Section 4 comprises:
- Drivers and constraints
- Historic production & pricing
- Biofuel production
- Sustainability Profile including Carbon Intensity

For each feedstock profiled in Section 4, Section 5 includes:
- Scenario assumptions
- Business as usual, Base and Aggressive Adoption scenarios:
  - Supply / Availability
  - Pricing

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Planned Table of Contents: Volume 3: Sugar / Starch / Carbohydrate Feedstocks

Each section in Section 4 comprises:

- Drivers and constraints
- Historic production & pricing
- Biofuel production
- Sustainability Profile including Carbon Intensity

For each feedstock profiled in Section 4, Section 5 includes:

- Scenario assumptions
- Business as usual, Base and Aggressive Adoption scenarios:
  - Supply / Availability
  - Pricing

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Planned Table of Contents: Volume 4: Emerging Feedstocks

Each section in Section 4 comprises:

- Drivers and constraints
- Historic production & pricing
- Biofuel production
- Sustainability Profile including Carbon Intensity

For each feedstock profiled in Section 4, Section 5 includes:

- Scenario assumptions
- Business as usual, Base and Aggressive Adoption scenarios:
  - Supply / Availability
  - Pricing

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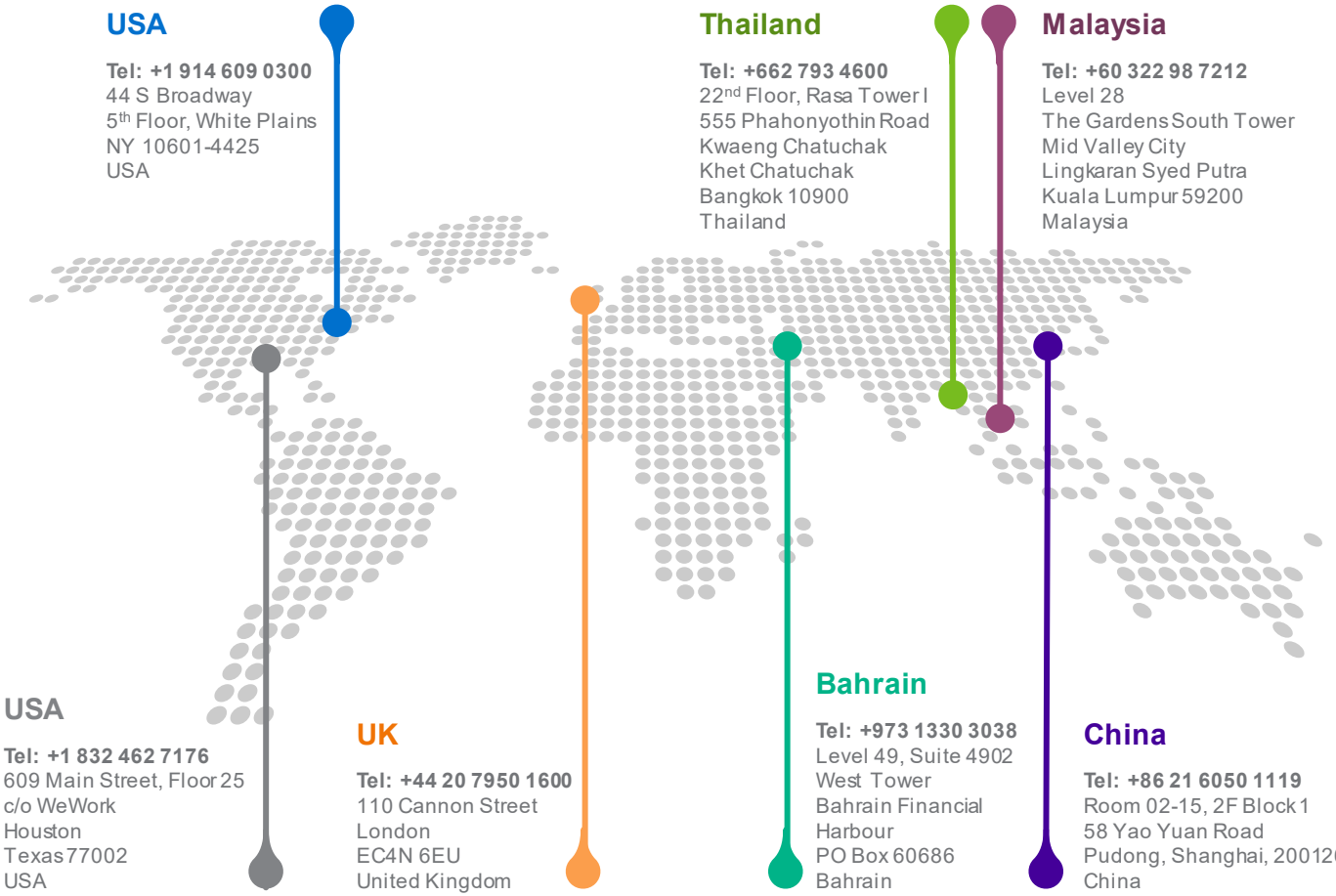

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