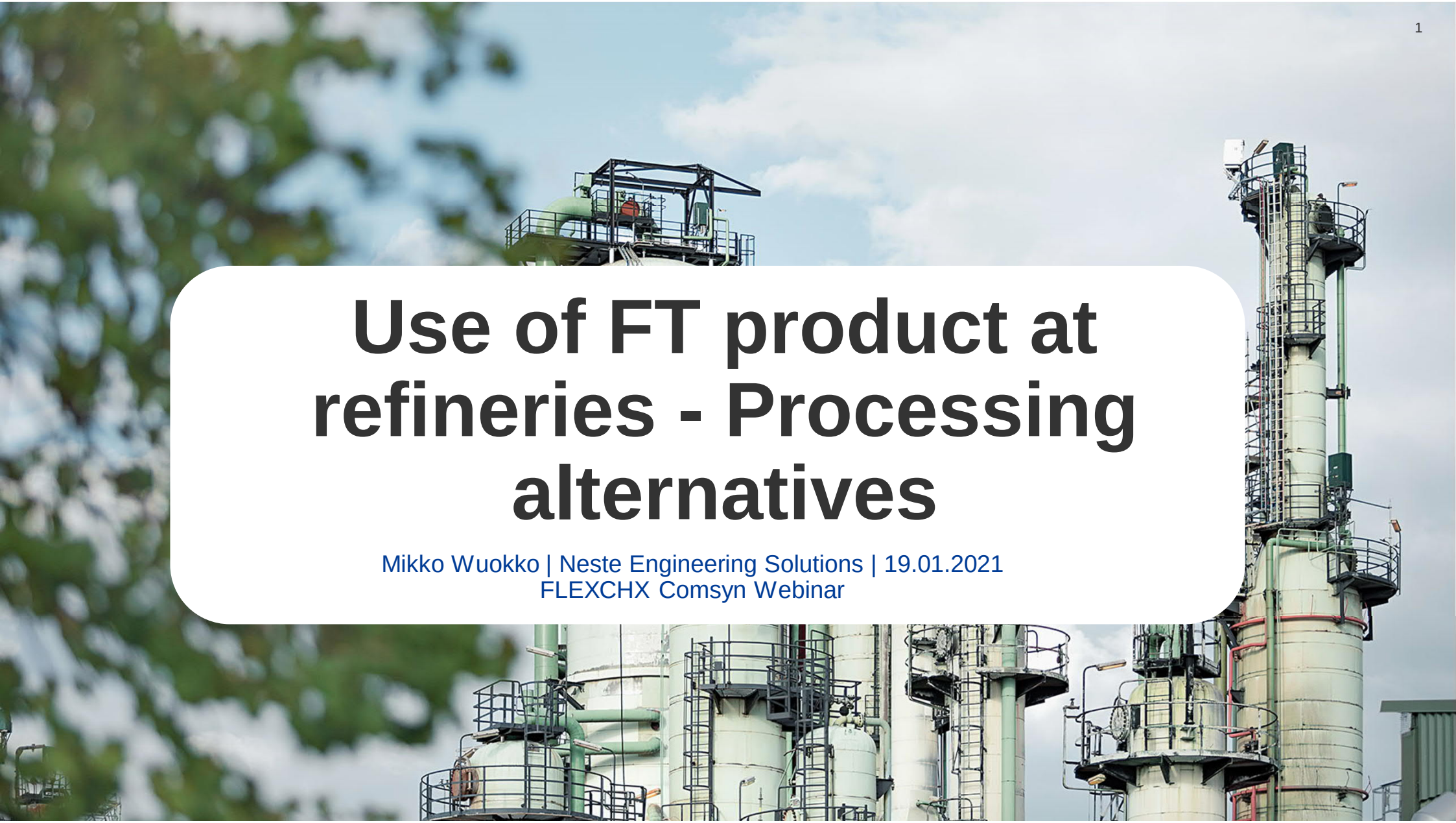
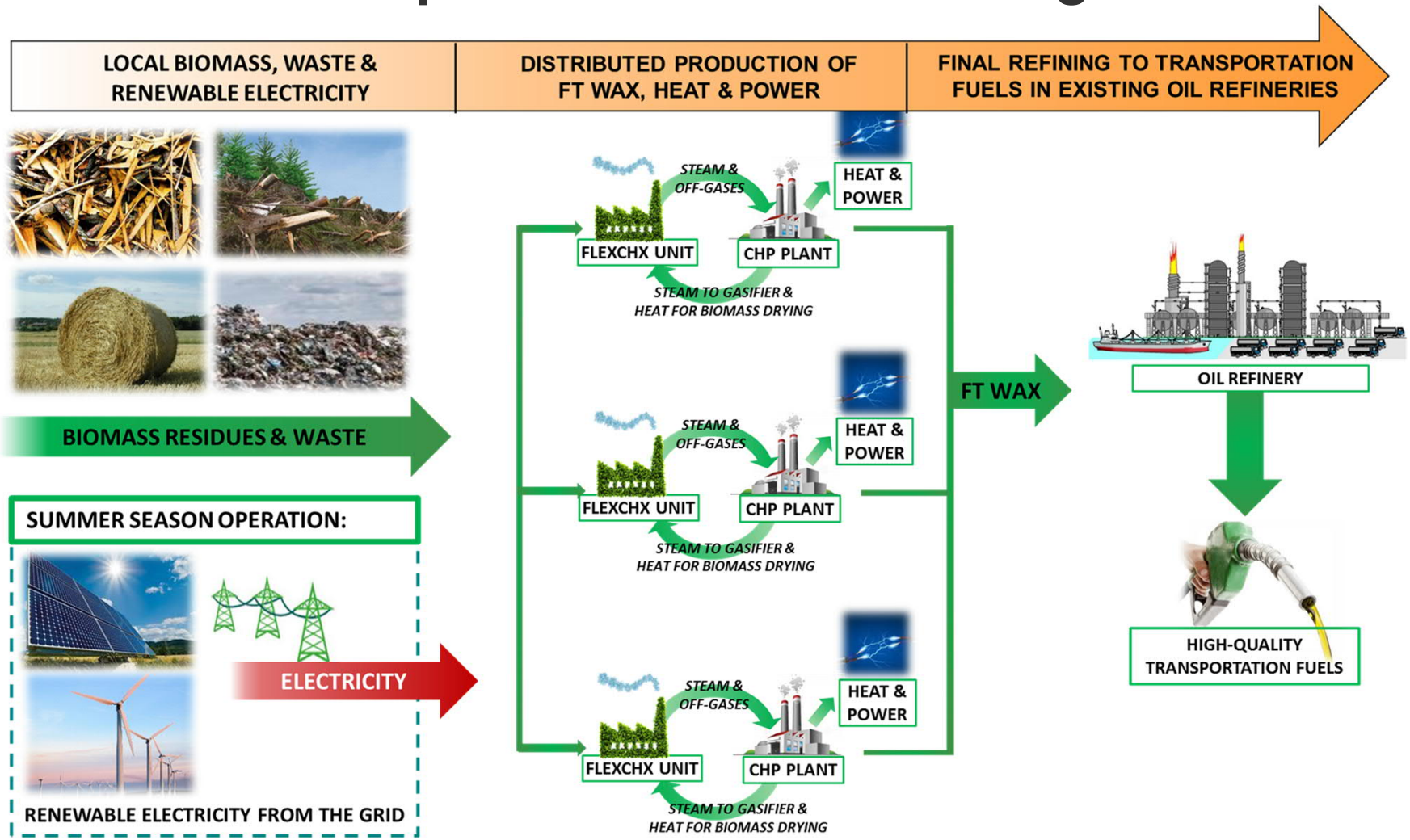


Use of FT product at refineries - Processing alternatives

Mikko Wuokko | Neste Engineering Solutions | 19.01.2021
FLEXCHX Comsyn Webinar

FLEXCHX concept - Centralized refining



Introduction

FLEXCHX units produce Fischer-Tropsch synthesis product, so-called **FT syncrude**

Eight different co-processing pathways for FLEXCHX syncrude were defined for seven product

The potential integration facilities were an **oil refinery, steam cracker and an HVO plant**

The **European product market** for interesting products also was defined, as well as a further look into a possible Finnish integration case

Preliminary **risk assessment** of refinery integration will be also concluded

Studied FLEXCHX FT syncrude co-processing product opportunities

Oil refinery
- Motor-gasoline
- Diesel
- Jet fuel

HVO plant
- Renewable diesel
- Renewable jet

Steam cracker
- Ethylene
- Propylene

Definition of FT syncrude

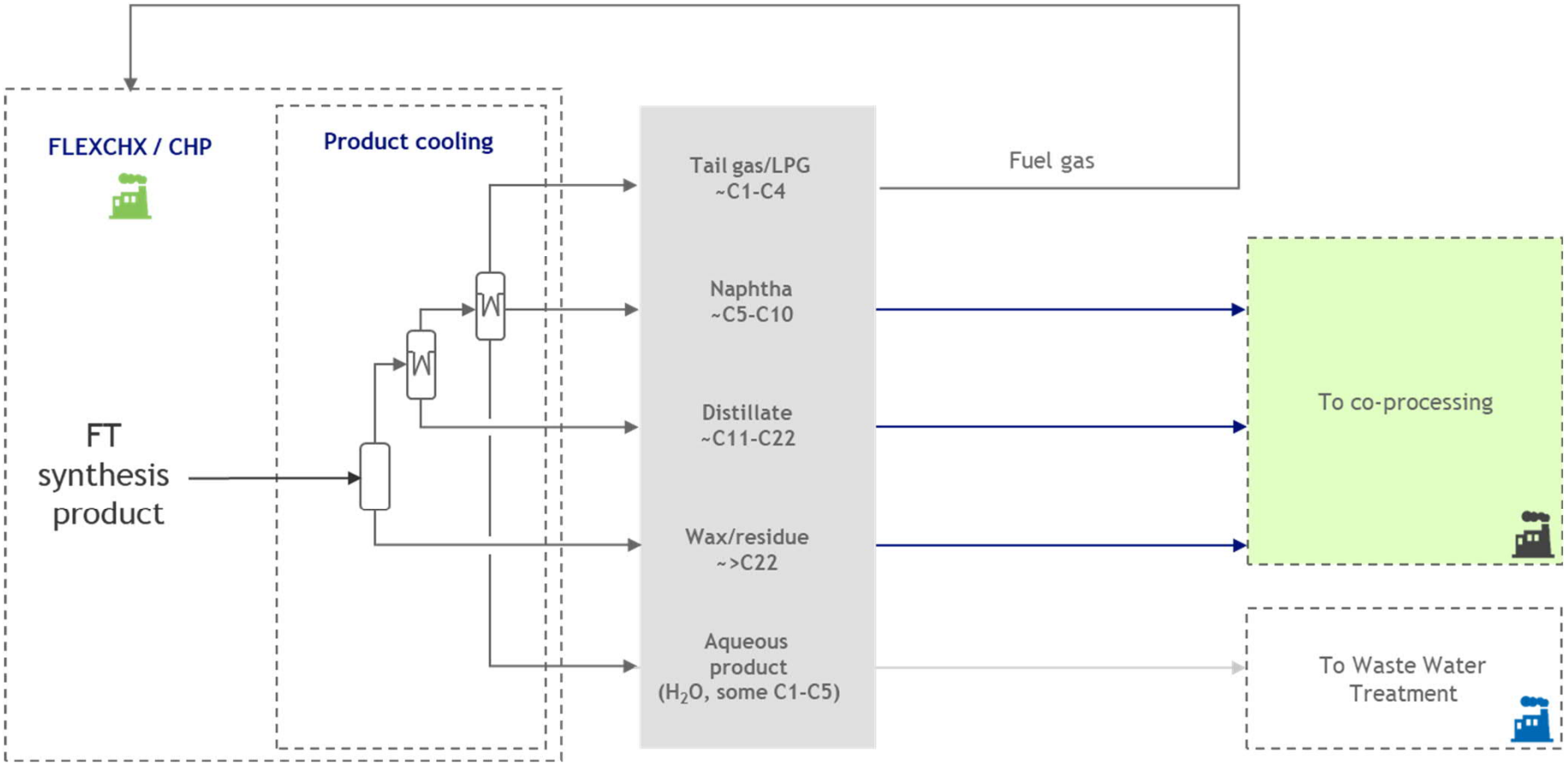
FLEXCHX syncrude composition was estimated in order to estimate suitability for different co-processing methods

Assumed composition was cobalt-based low-temperature Fischer-Tropsch syncrude derived from literature

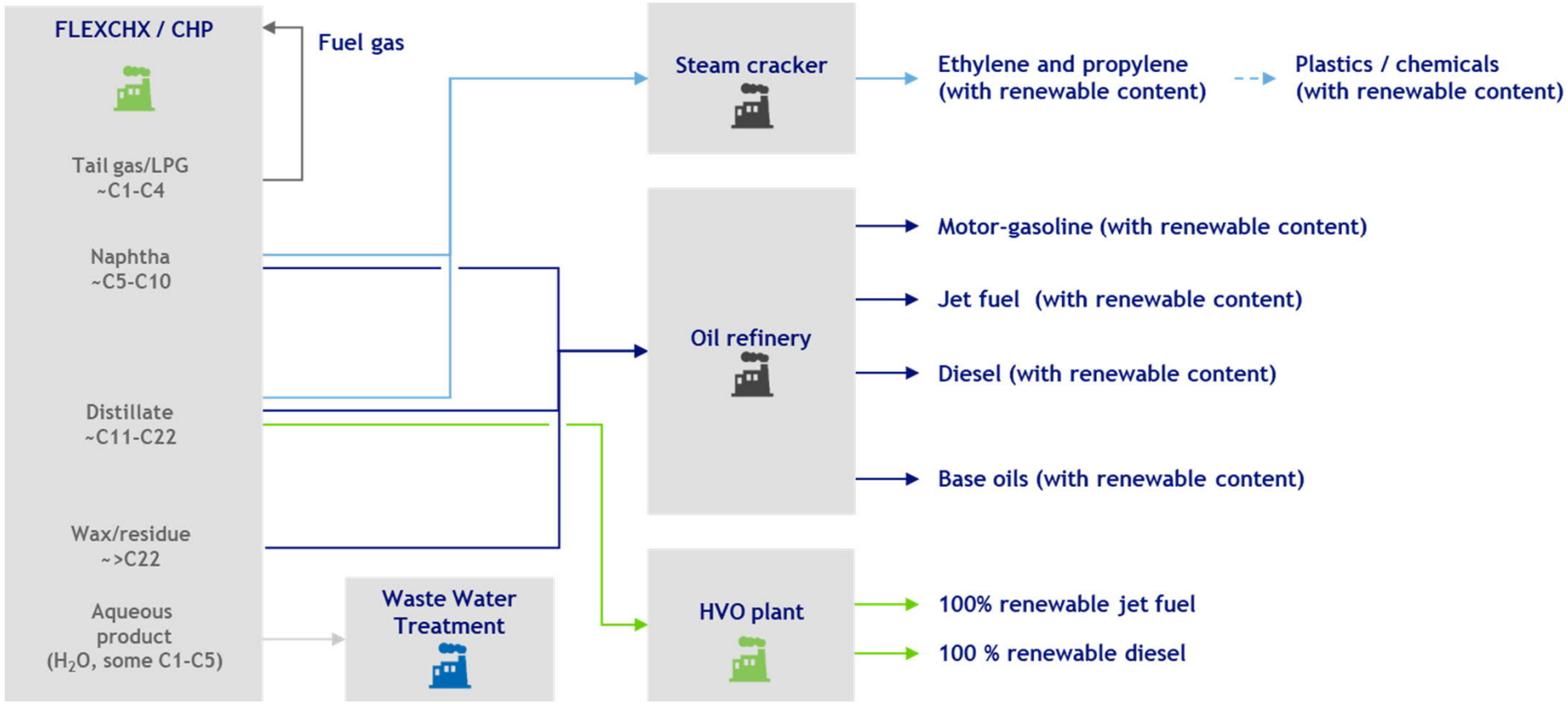
Product fraction	Carbon range	Share of product fraction (%)
Tail gas	C1-C2	7
LPG	C3-C4	5
Naphtha	C5-C10	20
Distillate	C11-C22	22
Wax	>C22	44
Aqueous product	C1-C5	2

FT syncrude is similar in composition and quality to fossil crude oil

FT syncrude fractionation scheme



Potential FLEXCHX syncrude integration pathways



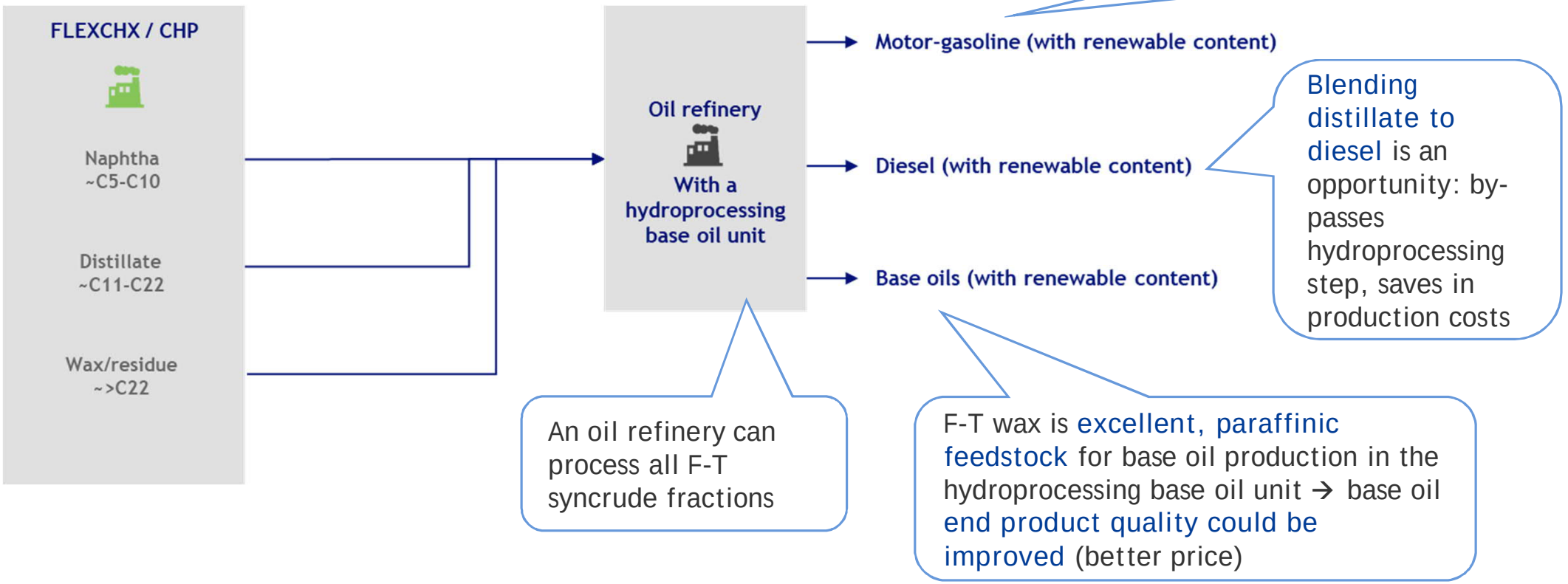
FT fraction as feedstock for product	Positive	Negative
F-T naphtha for motor gasoline	• Renewable hydrocarbon gasoline component • Sulphur-free feedstock	• Low octane number • High olefin content
F-T distillate for diesel	• Mainly n-paraffins; high cetane number • Mainly n-paraffins (low density) → good density adjuster for fossil diesel • Possibly suitable as direct diesel blendstock • Sulphur-free feedstock	• Mainly n-paraffins; poor cold flow properties. Isomerization required, which is typically not available for diesel range in oil refineries
F-T distillate for jet fuel	• Mainly n-paraffins (low density) → good density adjuster for fossil jet • No aromatics → good smoke point adjuster for fossil jet • Sulphur-free feedstock • Low oxygen and metal content → low hydrotreatment requirement at an HVO plant	• Mainly n-paraffins; poor cold flow properties. Isomerization required (which available at HVO plants).
F-T wax (~C23-C45) for base oils	• Practically solely n-paraffins (very high viscosity index) → excellent feedstock for Group III base oils	• Practically solely n-paraffins (poor pour point); Hydroprocessing base oil unit required for co-processing
F-T wax for transportation fuels	• Sulphur- and metal-free feedstock for cracking • Hydrocracking increases the degree of branching, improving the cold flow properties of the cracked products	• Cracking produces a range of products, including lights
F-T naphtha and distillate for ethylene and propylene	• n-paraffins are excellent feedstock for steam cracker	• High olefin content (can cause coking); hydrotreatment of F-T naphtha/distillate possibly required prior co-feeding • Feed may contain oxygenates. Depending on type, oxygenates can create technical issues in crackers

FT syncrude co-processing suitability

FT fraction to be co-processed	Main product	Integration facility	Co-processing suitability	Investment needs	Technical attractiveness
FT naphtha	Motor gasoline	Oil refinery	No major technical limitations	No major investment needs	Good
FT distillate	Diesel	Oil refinery	Possibly suitable for direct blending Cold flow properties a limiting factor	Isomerization required for high blends	Good/ Adequate
FT distillate	Renewable diesel	HVO plant	No major technical limitations	No major investment needs expected	Good
FT distillate	Jet fuel	Oil refinery	Expected poor cold flow properties for product with existing refinery units	Isomerization required for high blends	Poor
FT distillate	Renewable jet fuel	HVO plant	No major technical limitations Isomerization typically included in HVO plants	No major investment needs expected	Good
FT wax	Base oils	Oil refinery	Hydroprocessing base oil unit required	No major investment needs expected	Good
FT wax	Transportation fuels	Oil refinery	No major technical limitations	No major investment needs expected	Good
FT naphtha and/or distillate	Ethylene and propylene	Steam cracker	Olefins in feed can cause coking Pre-treatment possibly required	Possibly hydrotreatment required as feed pre-treatment	Adequate/Poor

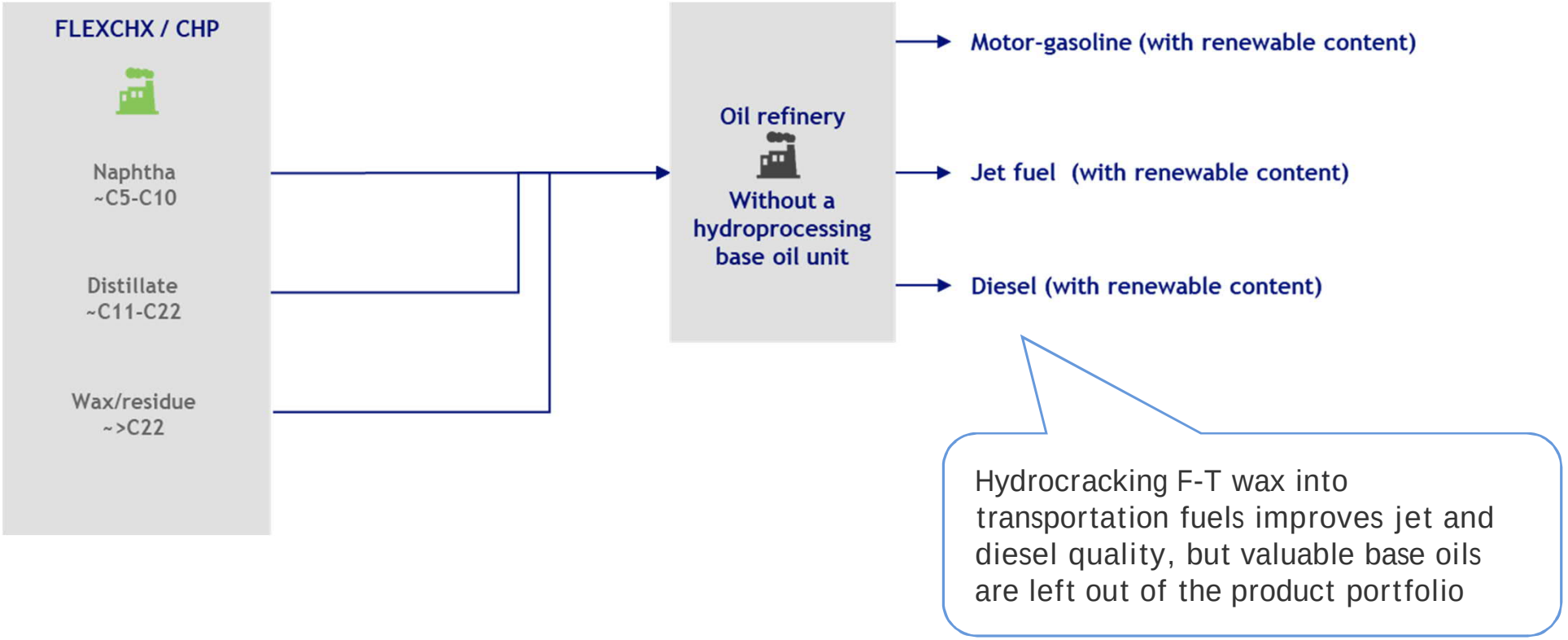
Integration case 1

Oil refinery with a hydroprocessing base oil unit



Integration case 2

Oil refinery without a hydroprocessing base oil unit

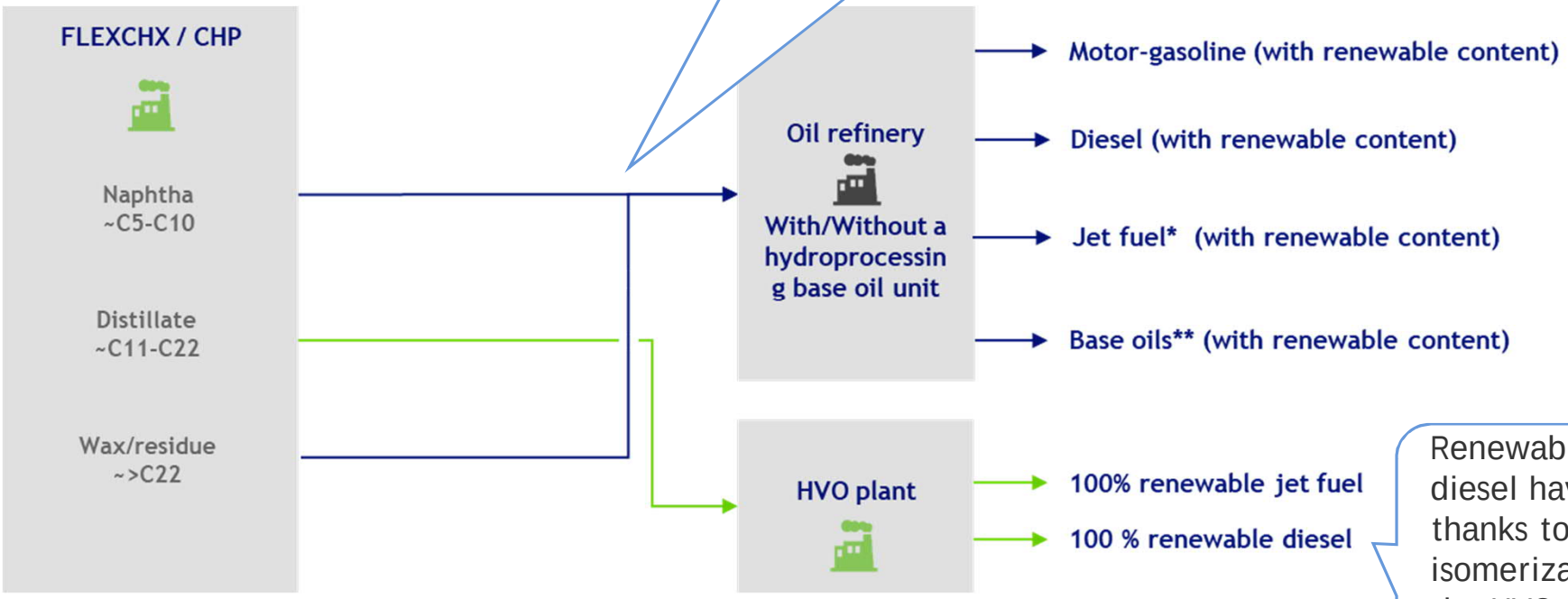


Integration case 3

HVO plant and oil refinery

An HVO plant can only process the distillate, other fractions need to be processed at an oil refinery

An ideal integration case is an HVO plant with an oil refinery at the same site



Renewable jet fuel and diesel have better quality thanks to the isomerization available at the HVO plant

*Produced in a refinery without a base oil unit
** Produced in a refinery with a base oil unit

Conclusions and next steps

A traditional oil refinery is likely well-suited for co-processing all the FT syncrude fractions, dedicated feeds could need modifications to assets

In order to reach most benefit from renewability, the FT syncrude naphtha could be processed at an HVO plant, but remaining fractions need to be processed elsewhere

Finland has potential for co-processing in existing renewable and traditional refining assets

A preliminary risk assessment will be performed to characterize technical risks in refinery integration

Thank you

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