



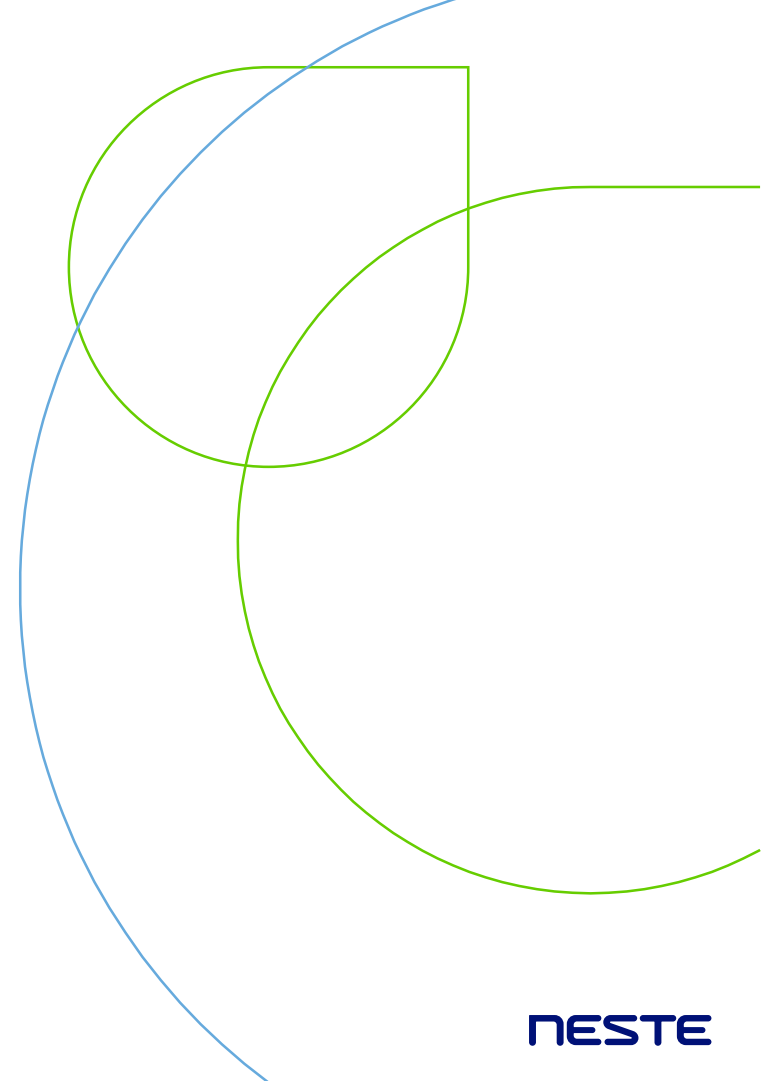
Neste perspectives and experiences in tracking bio-component in co-processed fuels

Sari Kuusisto, senior associate in R&D, Neste

Table of contents

1. Why Neste needs bio-component tracking?
Renewable products and co-processing
2. Bio-share determination with biogenic analysis
3. Conclusion

Why Neste needs bio- component tracking?



Challenges

An aerial photograph of Central Park in New York City, with the dense green trees in the foreground and the Manhattan skyline of skyscrapers in the background under a clear blue sky.

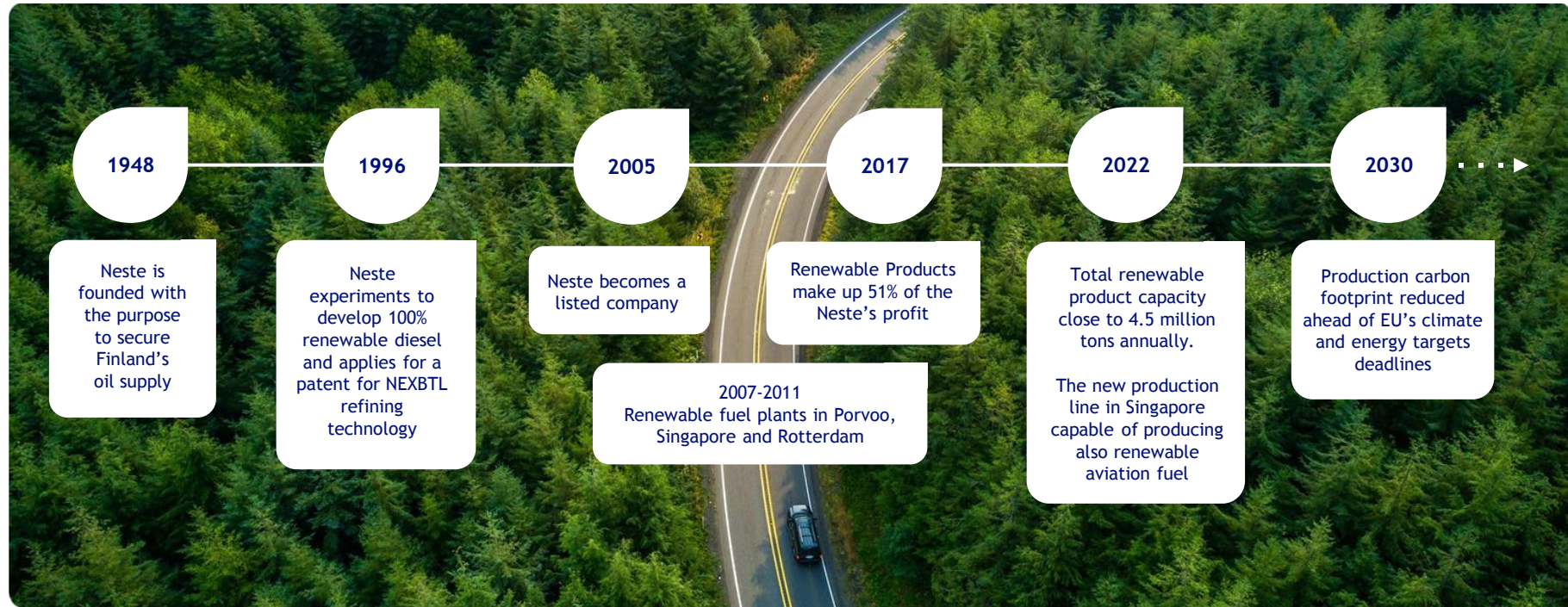
Climate change
requires seeking
alternative
sources of energy
and fuel

Targets to cut
greenhouse gas
emissions are
set around
the world

Within EU to
reduce
greenhouse gas
emissions by 80%
by 2050

**Increasing demand for energy
- how to tackle the challenge?**

Our journey from an oil refining company to the world's largest provider of renewable diesel



Our renewable products

Neste Renewable Fuels



Neste MY
Renewable
Diesel

Neste MY
Renewable
Gasoline

Neste MY
Renewable
Propane

Neste MY
Renewable Jet
Fuel

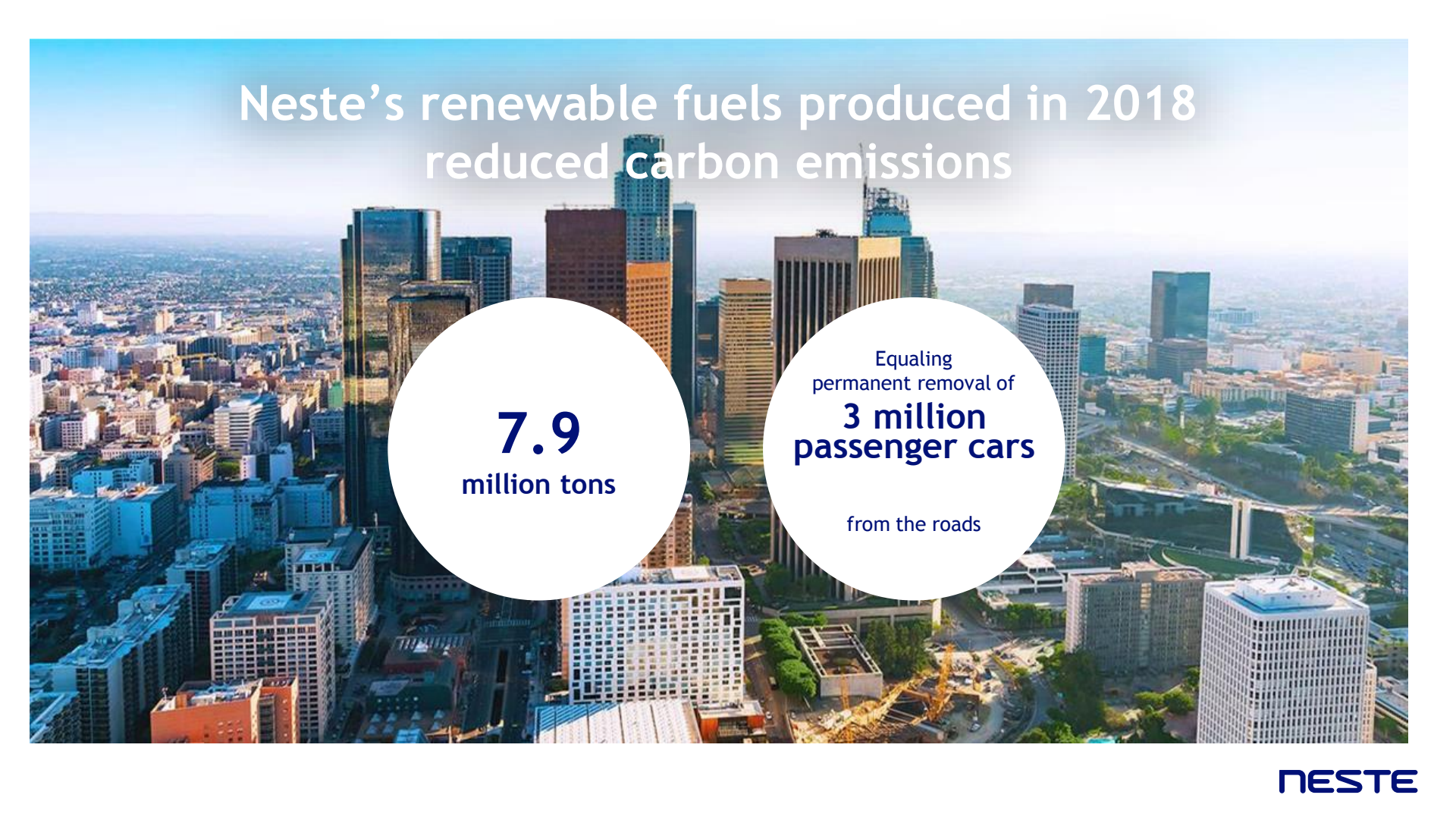
Neste Renewable Chemicals



Neste MY
Renewable
Isoalkane

Neste My
Renewable
Naphta

Neste MY
Renewable
Propane

An aerial photograph of a city skyline, likely Los Angeles, with numerous skyscrapers and a dense urban landscape. Two large white circles are overlaid on the image, containing text. The background is a clear blue sky.

Neste's renewable fuels produced in 2018 reduced carbon emissions

7.9
million tons

Equaling
permanent removal of
3 million
passenger cars

from the roads



Cutting-edge research

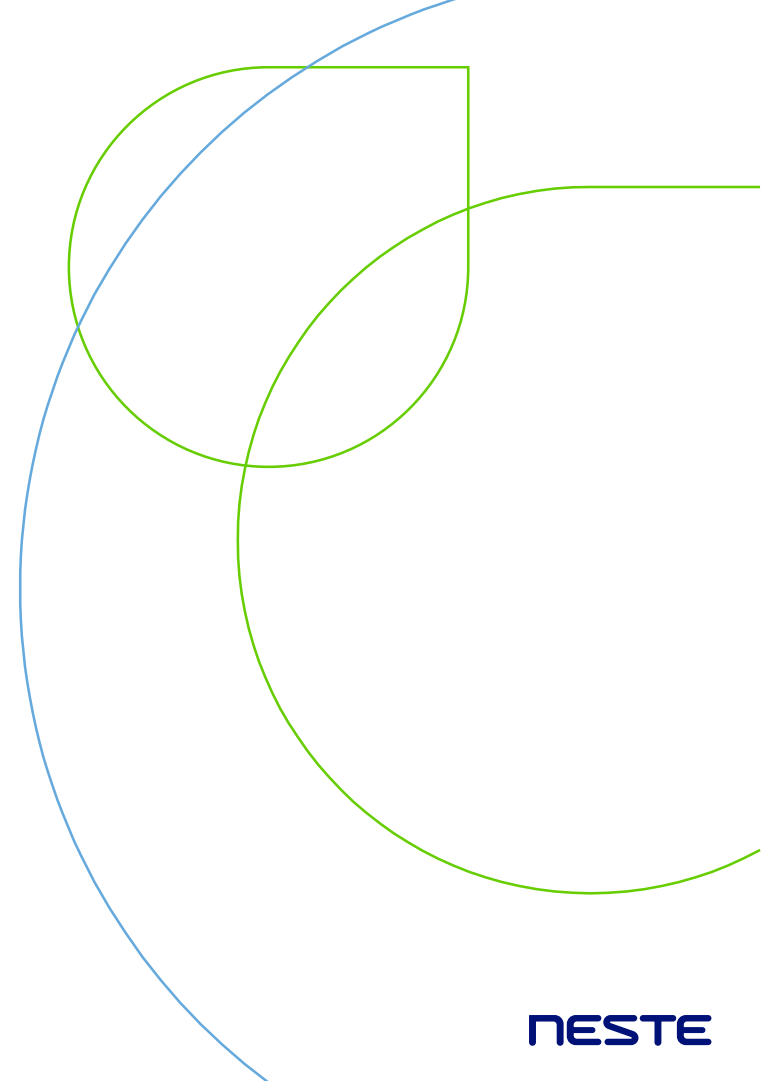
- Continuous research to expand renewable raw material base and further develop NEXBTL technology
- Approx. euro 48 million of R&D costs in 2018
- Cooperation with research institutions around the world
- Approx. 1,000 people working with research and engineering



Porvoo and Naantali oil refineries, Finland

- Neste's crude oil based production capacity 15 million tons per year
- Co-processed batches from 2014
- Bio-share equal allocation / simulation data -> true allocation
- General bio-share of blends of fossil and renewable fuels

Bio-share determination with biogenic analysis



How to prove the bio-share to the authorities, customs?

- Biocomponents that are chemically similar such as renewable diesel / HVO and fossil diesel, how to prove the bio-share
- Biogenic analysis
- Accelerator Mass Spectrometry (AMS) or Liquid Scintillation Counting (LSC) employing the principle of radiocarbon dating can be used to differentiate the biogenic and fossil component.

Two Established Techniques for Biogenic Analysis

Accelerator Mass Spectrometry - AMS

- + accurate
- + applicable: solids, gases, liquids
- 1+ MEUR instrument & laboratory
- large, bulky instrument
- requires skilled personnel
- laborious sample preparation
- slow response, ~ 2-3 weeks
- external labs



Liquid Scintillation Counting – LSC (direct LSC, DIN 51637)

- + fast analysis, 5-10 hrs typical
- + 1 lab. technician can operate
- + 100 kEUR & small instrument
- + very easy sample preparation
- + Neste in-house method
- applicable only to clear liquids



Neste Measurement Uncertainty

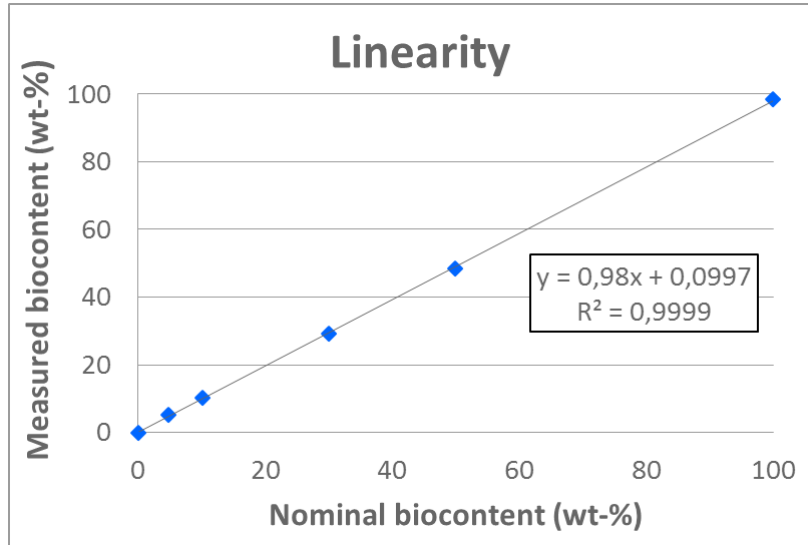
Neste validation resulted in the following measurement uncertainties
Liquid Scintillation Counting (LSC):

<u>Sample</u>	<u>Limit of Quantification</u>	<u>Measurement Uncertainty</u>
Diesel	1.4 <u>bio-wt-%</u>	1-45 <u>bio-wt-%</u> : +/- 13 % (<u>relative</u>)
<u>Gasoline</u>	0.8 <u>bio-wt-%</u>	1-25 <u>bio-wt-%</u> : +/- 2 <u>bio-wt-%</u> (<u>absolute</u>) 26-100 <u>bio-wt-%</u> : +/- 7 % (<u>relative</u>)

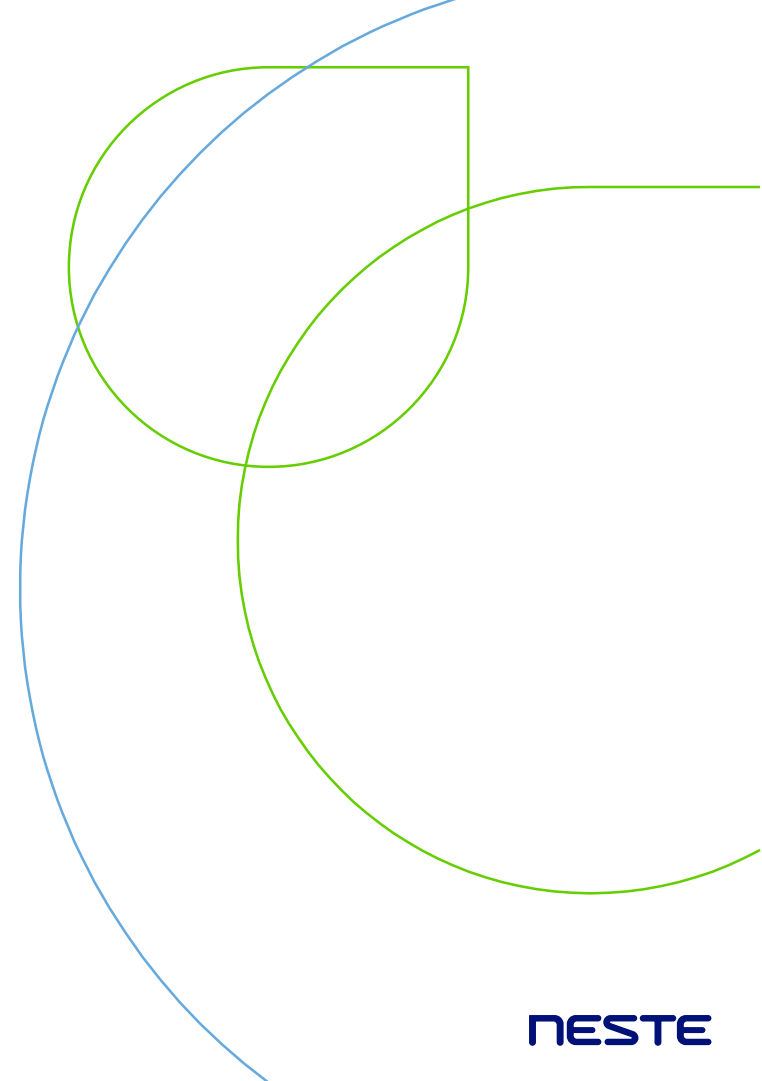
Validation results. Measurement uncertainty
corresponds to 95% confidence level.

Neste Measurement Uncertainty

Linearity of LSC results for diesel samples



Conclusions



Conclusions

- Co-processing is one way to increase the use of bio in traffic, also in biojet and other oil refinery products to reduce traffic carbon
- LSC normal routine/normal analysis in oil refinery laboratory providing accurate analysis of bio-content
- Excellent measurement methodology for legislative and authority purposes
- Validation with AMS, round robin tests?
- What could be the methodology for measuring recycled carbon content (renewable fuels of non-biological origin)?



Global 100:

**Neste is the 3rd most sustainable
company in the world.**





Thank you.

Sari.kuusisto@neste.com

NESTE