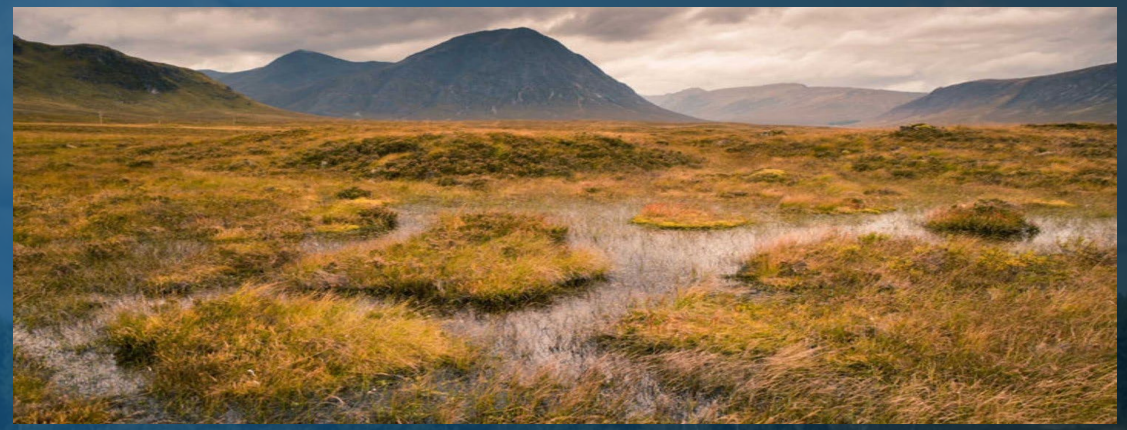
FROM TRADITION TO TRANSFORMATION

Improving Peated Malt Production with IonSmoke Technology

Shaping the Future of Malt

Why Responsible Peat Use Matters

- Peat forms over thousands of years, making it a finite and sensitive natural resource.
- Peatlands store carbon, support biodiversity, and help regulate local water systems.
- For traditional peated malt, the focus must be on using peat responsibly and efficiently.



Carbon store

Peatlands lock away carbon

Biodiversity

Supports specialist habitats

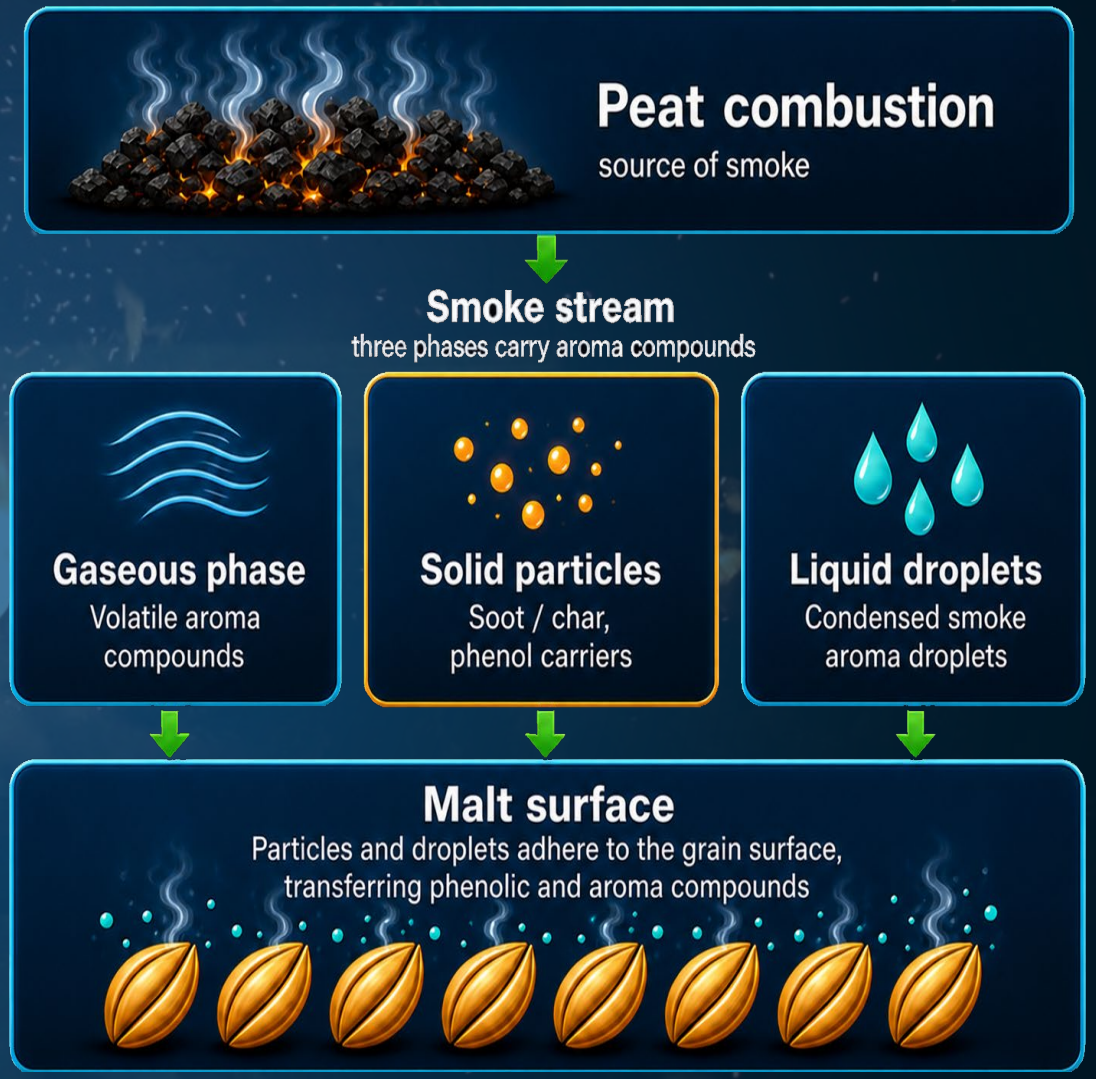
Water quality

Helps regulate local water systems

Responsible use = protect tradition while reducing impact

Smoke Composition

- Smoke is a **complex aerosol** made up of **gas**, **solid particles**, and **liquid droplets**.
- **Incomplete peat combustion** forms soot / char particles that can carry **phenolic smoke compounds**.
- As smoke cools, some vapour-phase compounds **condense into droplets**.
- During peating, **gases, particles, and droplets** contact the malt surface, supporting **phenolic and aroma compound uptake**.



Commitment to Responsible Peat Use

Three key areas

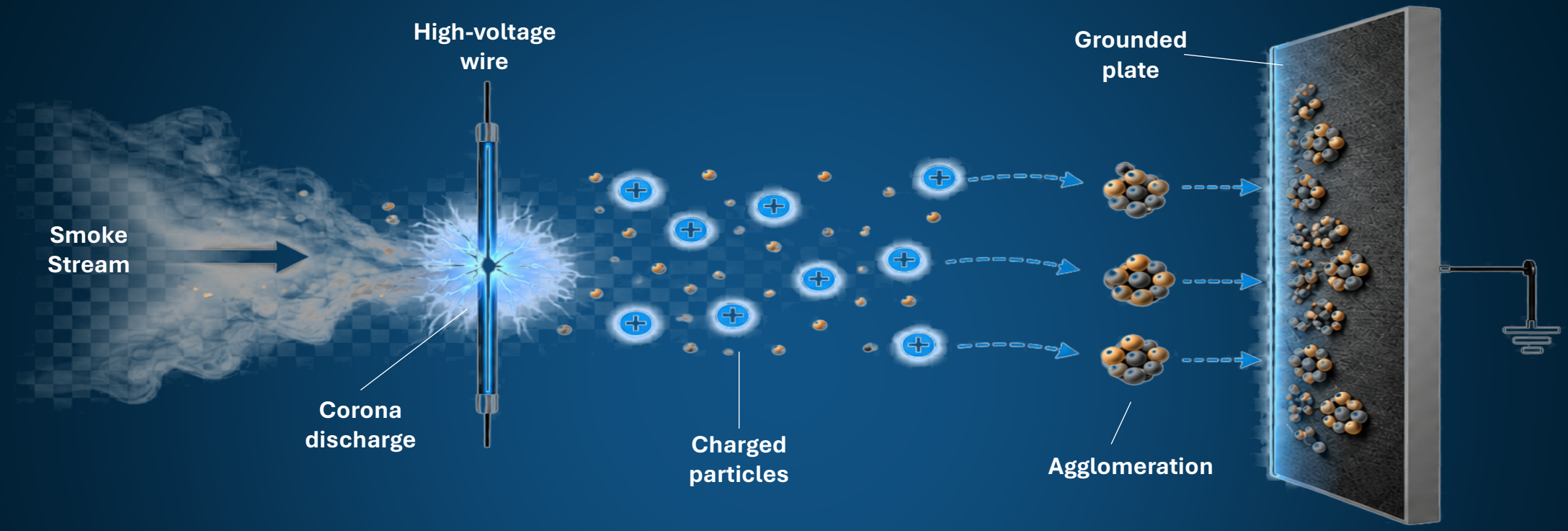
Responsible Extraction

Optimisation & Efficiency

Restoration & Stewardship

IonSmoke delivers on the SWA's CRPU framework — through Optimisation & Efficiency

What is Electrostatic Precipitation?



1 Electrostatic field
High voltage creates a field between the wire and grounded surface.

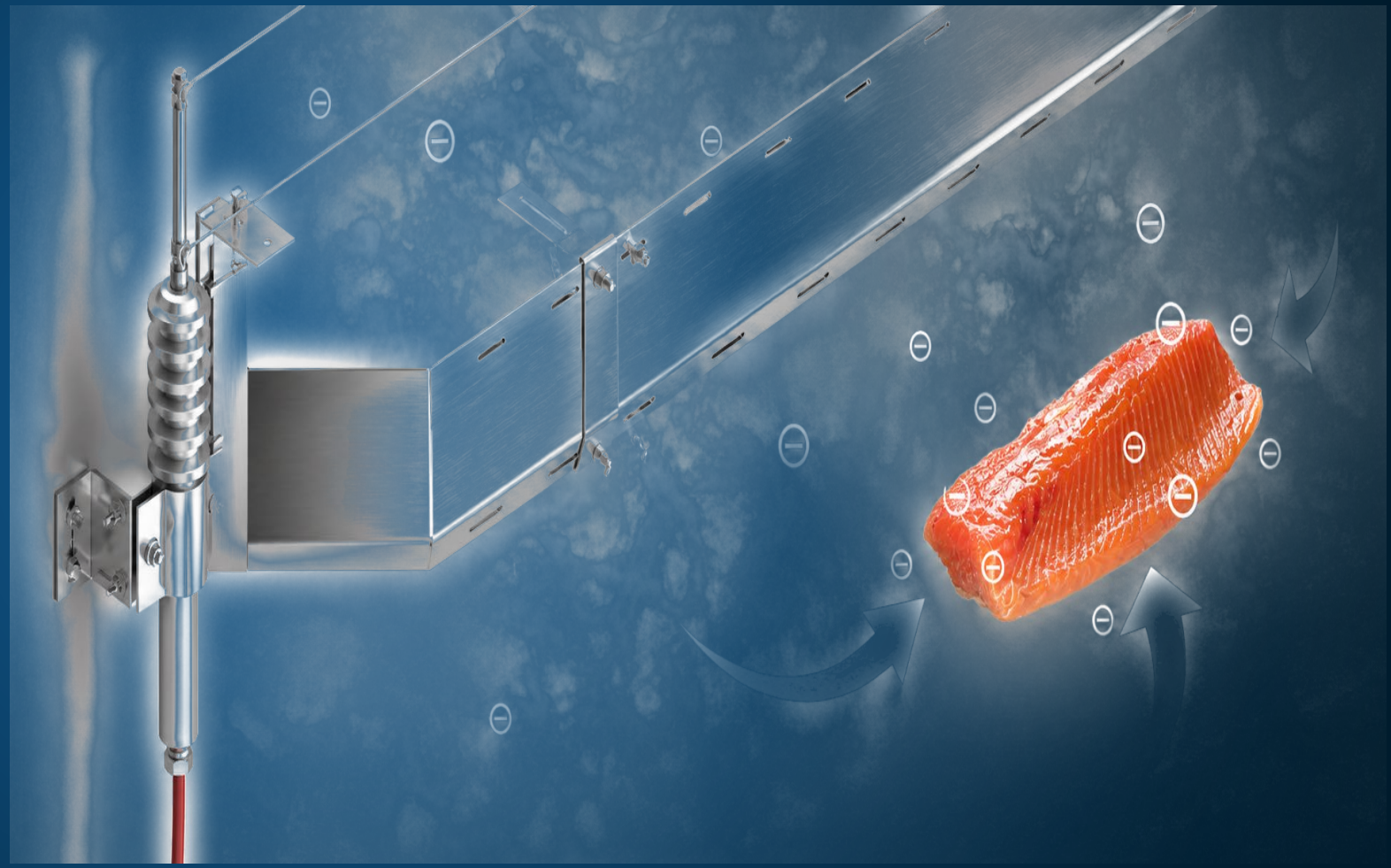
2 Ionisation
Smoke particles become electrically charged by corona discharge.

3 Attraction
Charged particles move toward the grounded surface.

4 Agglomeration
Particle collisions can form larger smoke particles.

EBSmoke – Proven in Food Industry

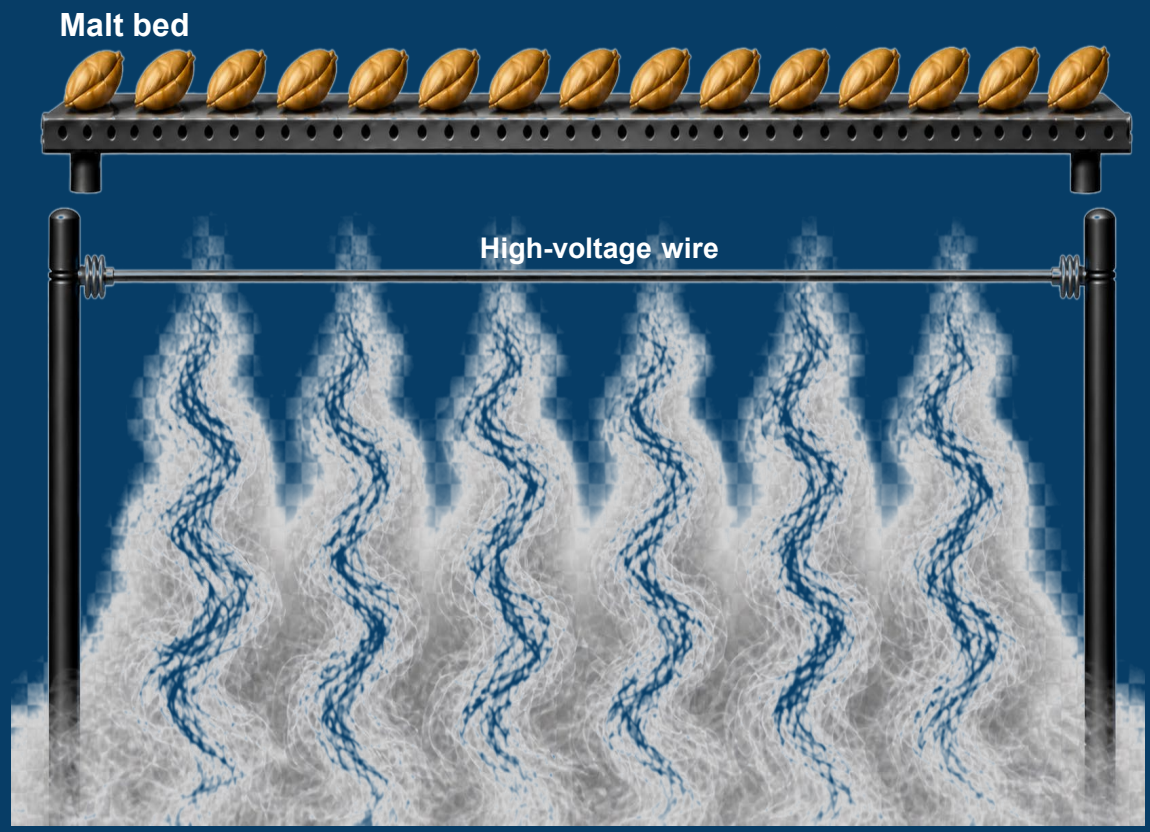
- EBSmoke are the inventors of the IonSmoke technology.
- The technology is already used in food-smoking applications.
- 170 systems in the food industry.
- Its application in malt peating is new and novel, supporting the Ion Smoke story in malt.



How IonSmoke Works in Malting

1 Smoke rises
Peat smoke rises from below the perforated floor.

Peat smoke → high-voltage wire → ionised smoke through malt bed



1 Smoke rises

How IonSmoke Works in Malting

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Smoke passes the high-voltage wire and some particles are ionised.

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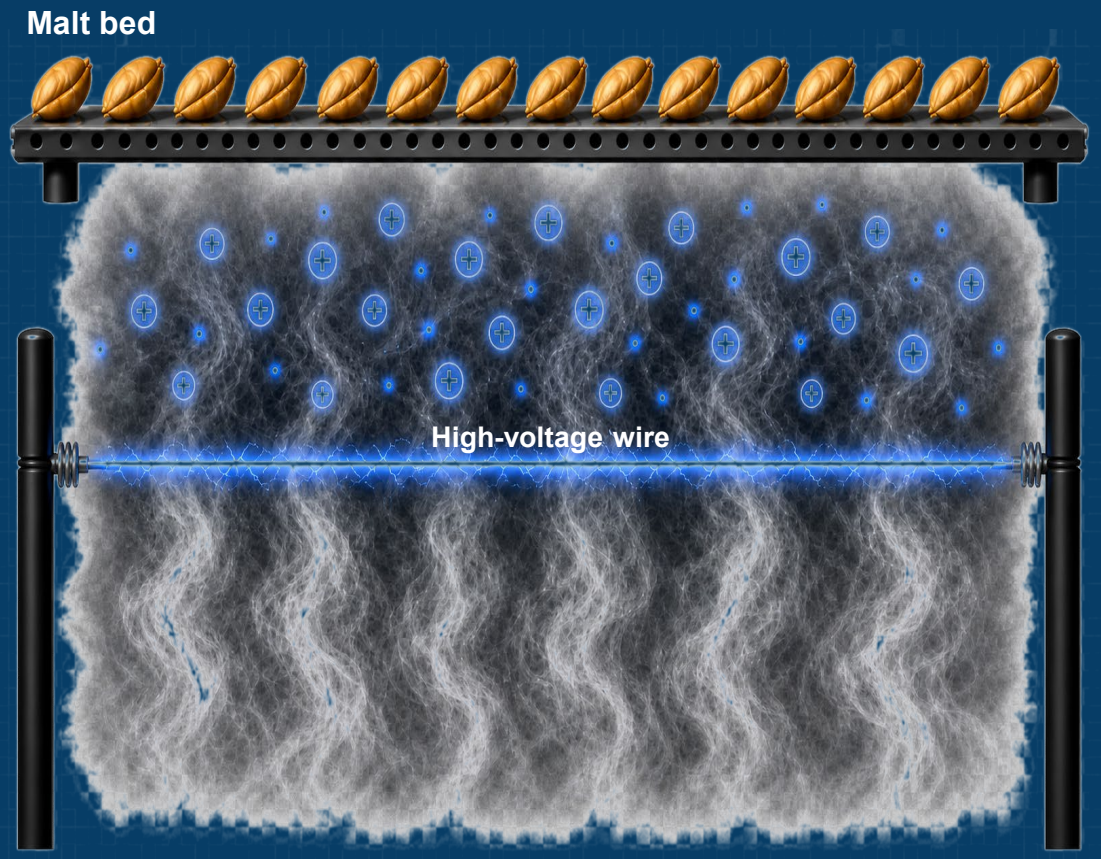


2 Ionisation at high-voltage wire

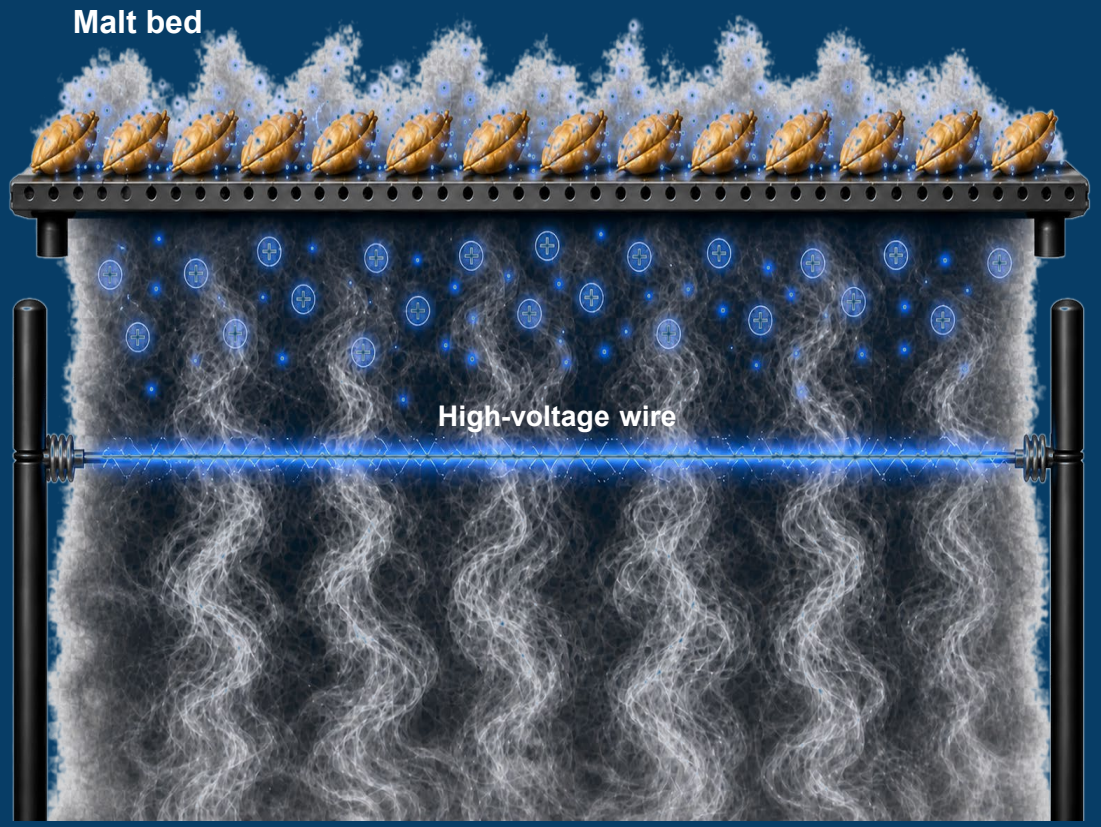
How IonSmoke Works in Malting

1. **Smoke rises**
   Peat smoke rises from below the perforated floor.

2. **Ionisation**
   Smoke passes the high-voltage wire and some particles are ionised.

3. **Through-bed flow / Malt uptake**
   Ionised smoke continues upward through the malt bed.
   Charged smoke particles transfer onto the malt surface.

Peat smoke → high-voltage wire → ionised smoke through malt bed



3 Ionised smoke passes through malt bed

Ionsmoke System Set-Up

ESP installation, kiln-inlet positioning and malt-bed transfer

SET-UP SEQUENCE

01

INSTALLATION

High-voltage ESP installed

30,000 V

EBSmoke installed the ESP system at the Pauls Malt Glenesk site.

02

KILN AIR INLET

Peat smoke crosses the ionisation field

The ESP is positioned at the kiln air inlet, so peat smoke passes directly across the field.

03

KILN BED TRANSFER

Ionised smoke continues through the kiln bed

This supports transfer of phenolic and aroma compounds onto the malt.

Smoke path: kiln air inlet → ionisation field → kiln bed → malt transfer

ESP installation below kiln inlet

Corona discharge during operation

Malt Peating Procedure

01 **Standard kiln process**
Malt was peated using the standard site kiln process.

02 **Controlled kiln cycle**
Withering and curing stages were managed as part of the cycle.

03 **Batch peat measurement**
Peat usage was recorded consistently and converted to weight basis.

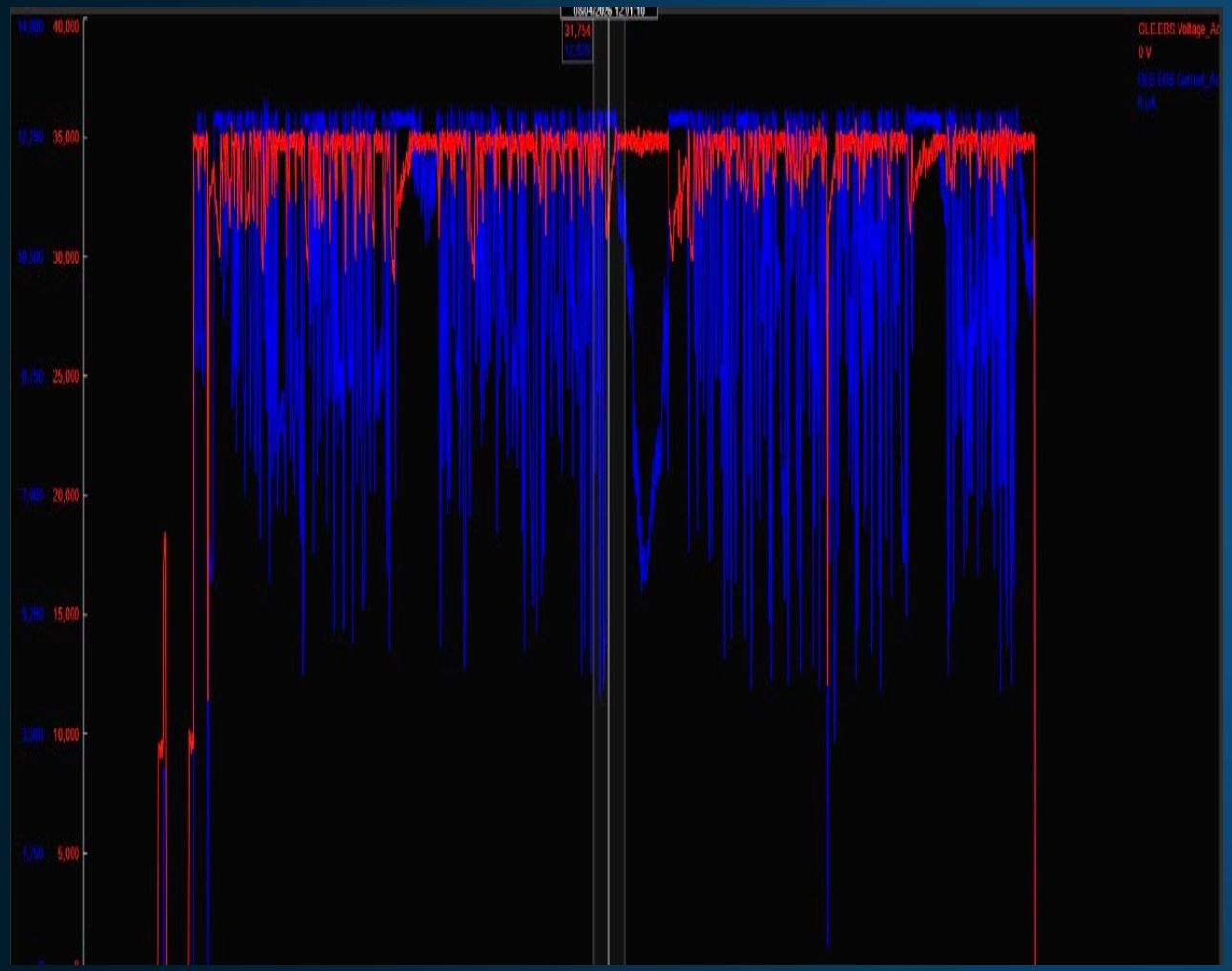
04 **ESP-treated batches**
The Ion Smoke system operated at the agreed trial setting.

05 **Phenolic marker analysis**
Smoke markers were quantified using HPLC at Boortmalt and SWRI Labs.

Output: comparable peat loading and phenolic smoke marker data

Reading the Smoke: Ionsmoke as a Peating Control Signal

Voltage and corona current provide a real-time signal of smoke density during peating.



Red = voltage (kV) · Blue = corona current (µA)

WHAT IT SHOWS

- **Voltage** stays close to the operating setpoint.
- **Corona current drops** when smoke density increases.
- Downward current spikes indicate **heavier smoke loading**.
- This provides an **objective measure of smoke exposure** during the peating cycle.

HOW IT CAN BE USED

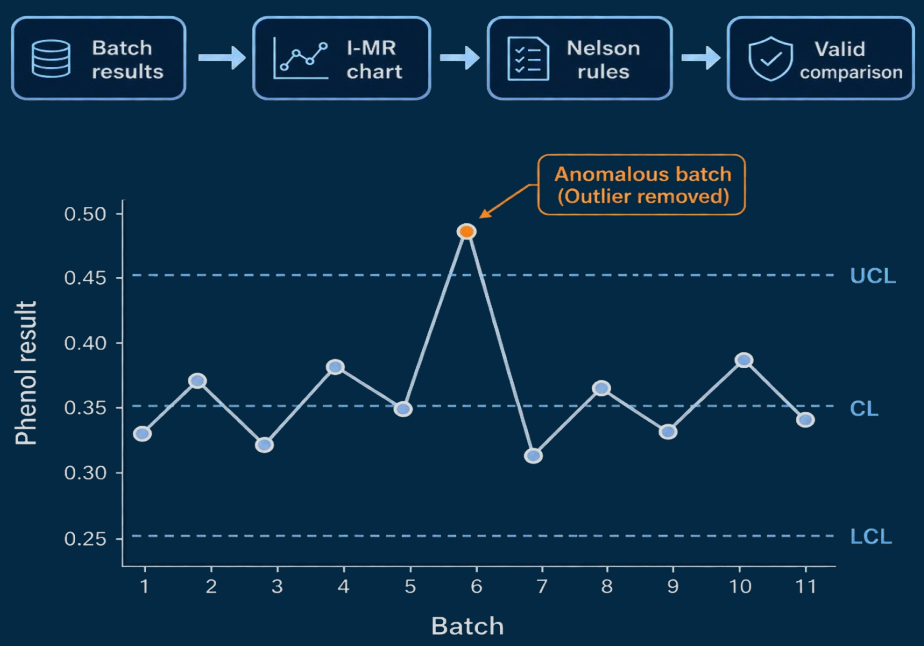
Score each cycle
Benchmark each peating run for **consistency**, **total exposure**, and **deviation**.

Support operators in real time
Use a simple **red / amber / green signal** to indicate **hold**, **continue**, or **back off** during peating.

Improve control
Helps turn peating from a **subjective process** into a more **measurable and repeatable** one

Statistical Process Control

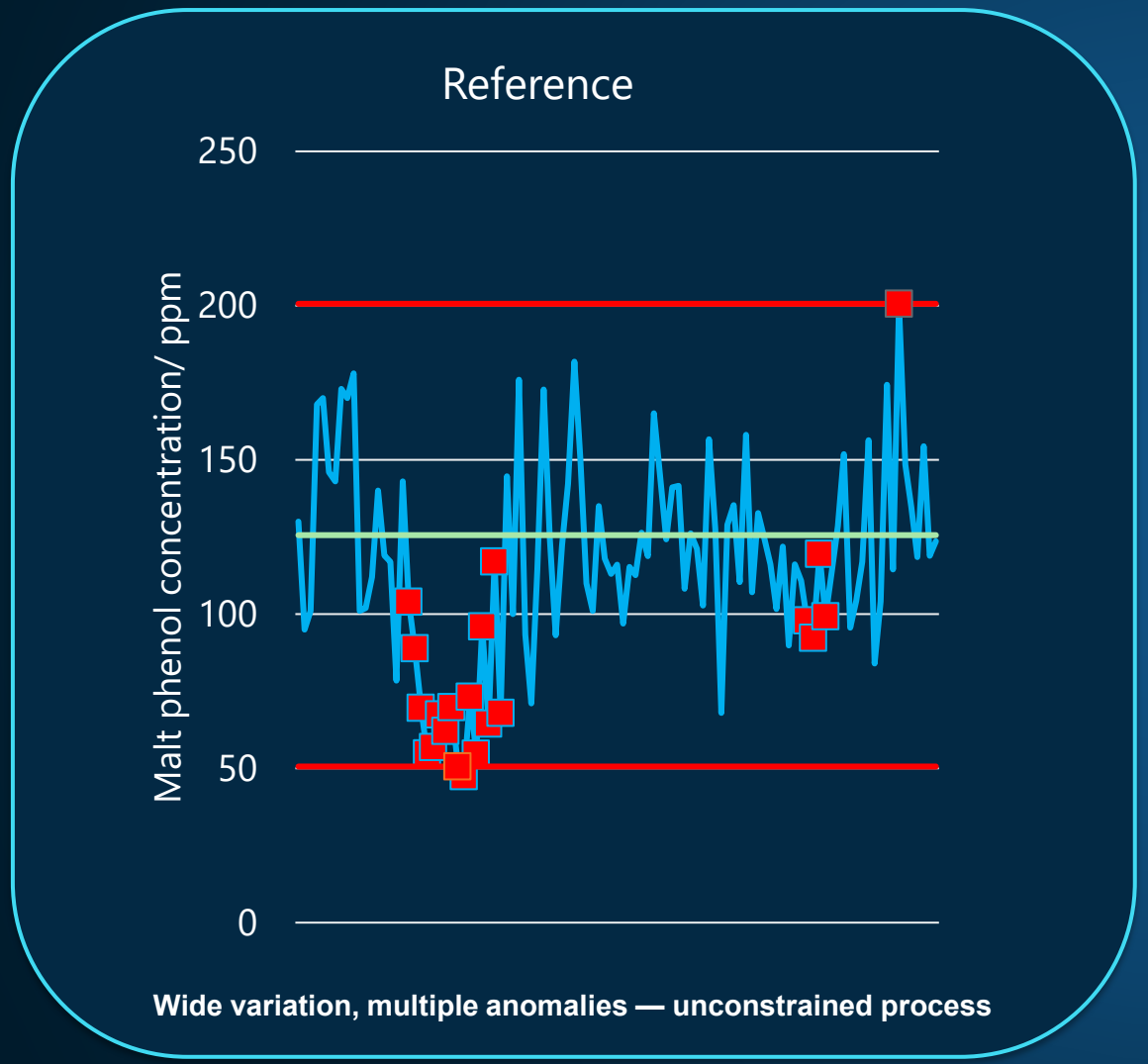
- Peat smoking is a **variable process**, influenced by environmental and process factors.
- **SPC methodology** was used to separate normal process variation from unusual batch results.
- **I-MR charts** and **Nelson rules** were applied to identify anomalous results before comparing test groups.



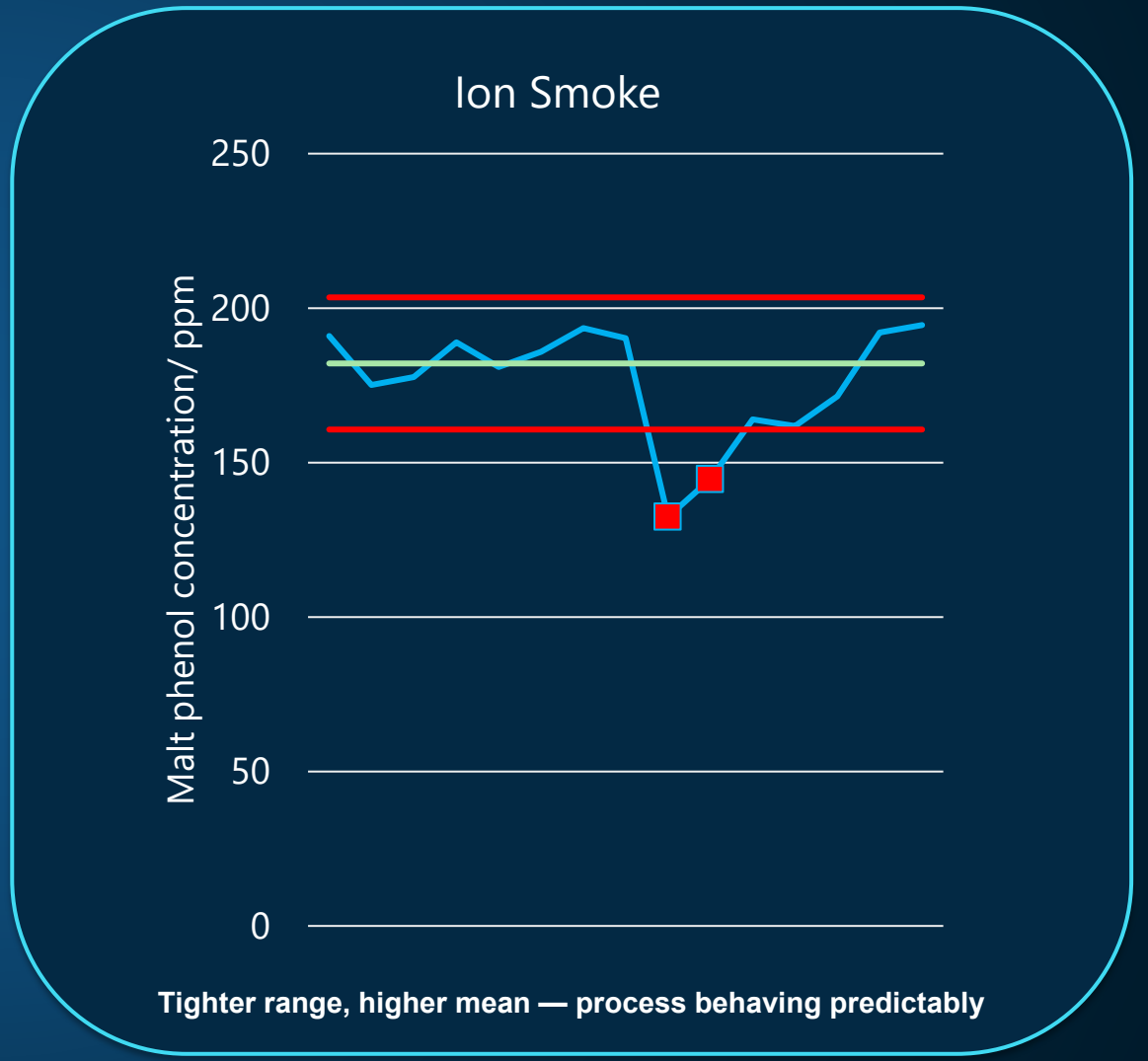
Separates abnormal results from normal process variation.

Establishing a baseline using statistical process control

I-MR control charts of malt phenol concentration. Out-of-control batches (Nelson rules) excluded before comparison.



Wide variation, multiple anomalies — unconstrained process



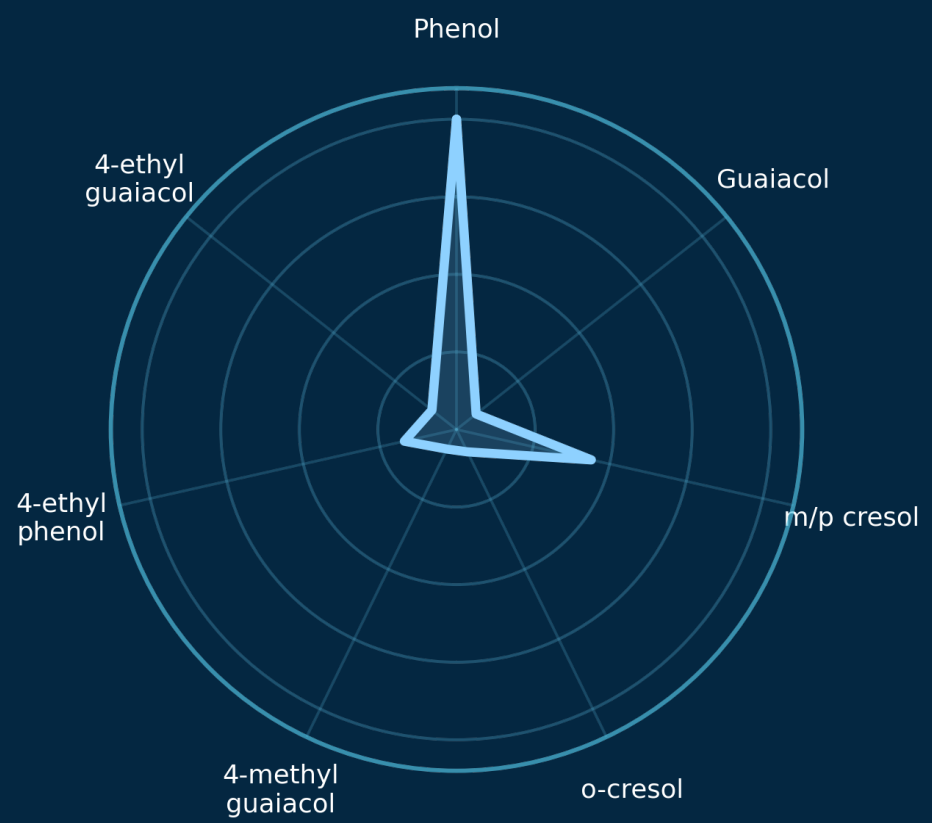
Tighter range, higher mean — process behaving predictably

Mean Control limits Out-of-control batch (Nelson)

Phenolic Smoke Profile

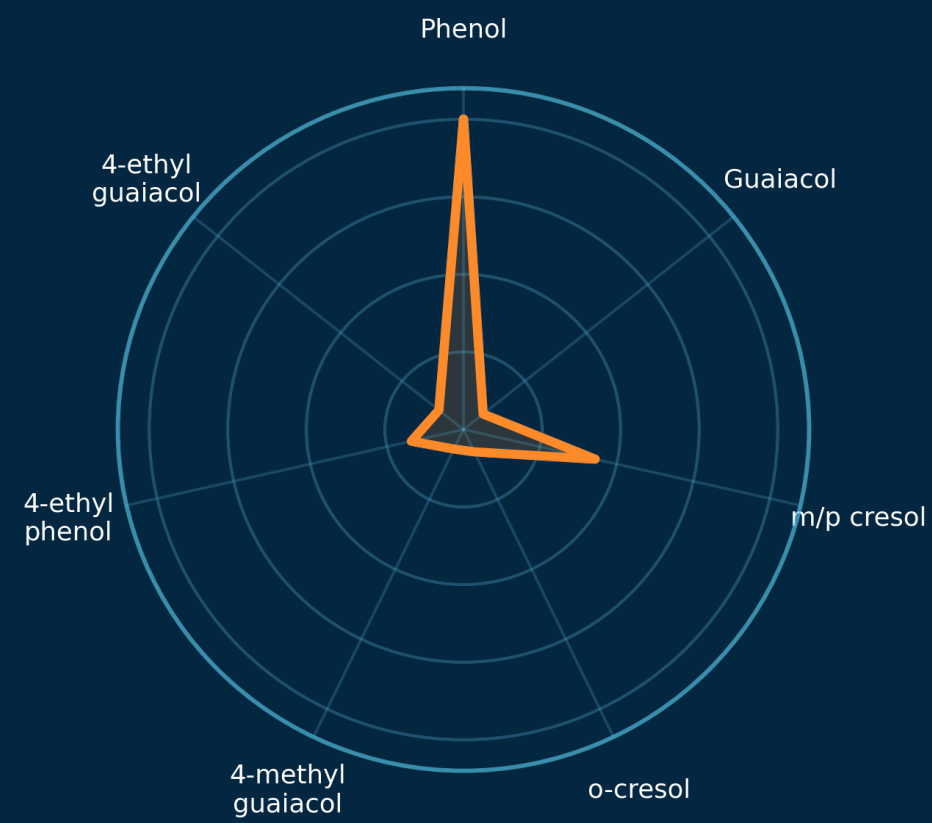
Relative compound ratios show a similar profile shape between reference and Ion Smoke malt.

Reference



Relative profile normalised to phenol = 100

IonSmoke



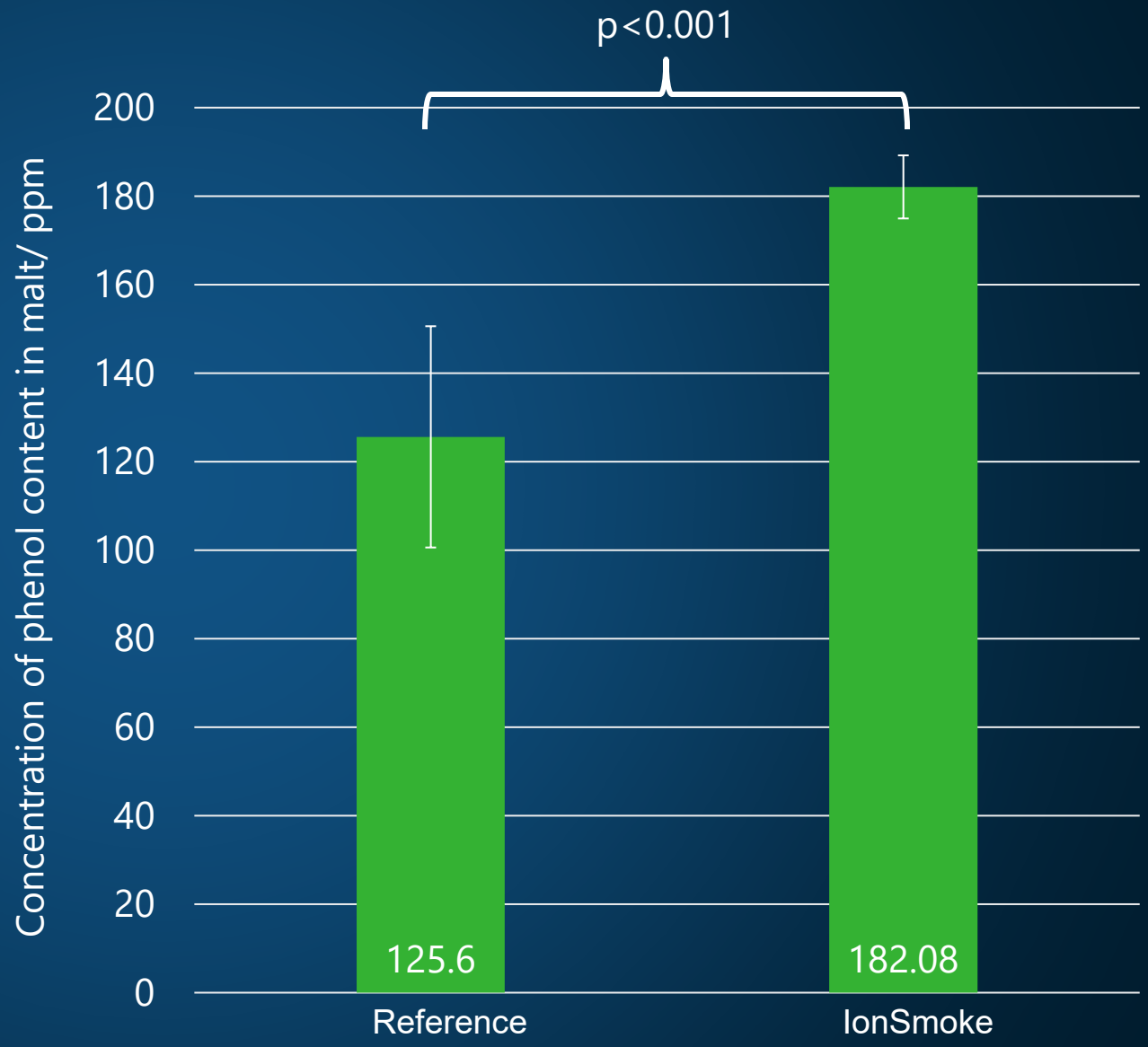
Relative profile normalised to phenol = 100

Increase in Malt Phenol ppm

38.1-51.8% increase in mean **phenol concentration** (CI= 0.95)

The **standard deviation** decreased from **20% to 4%**

Operational efficiencies from increased **phenol concentration** in malt

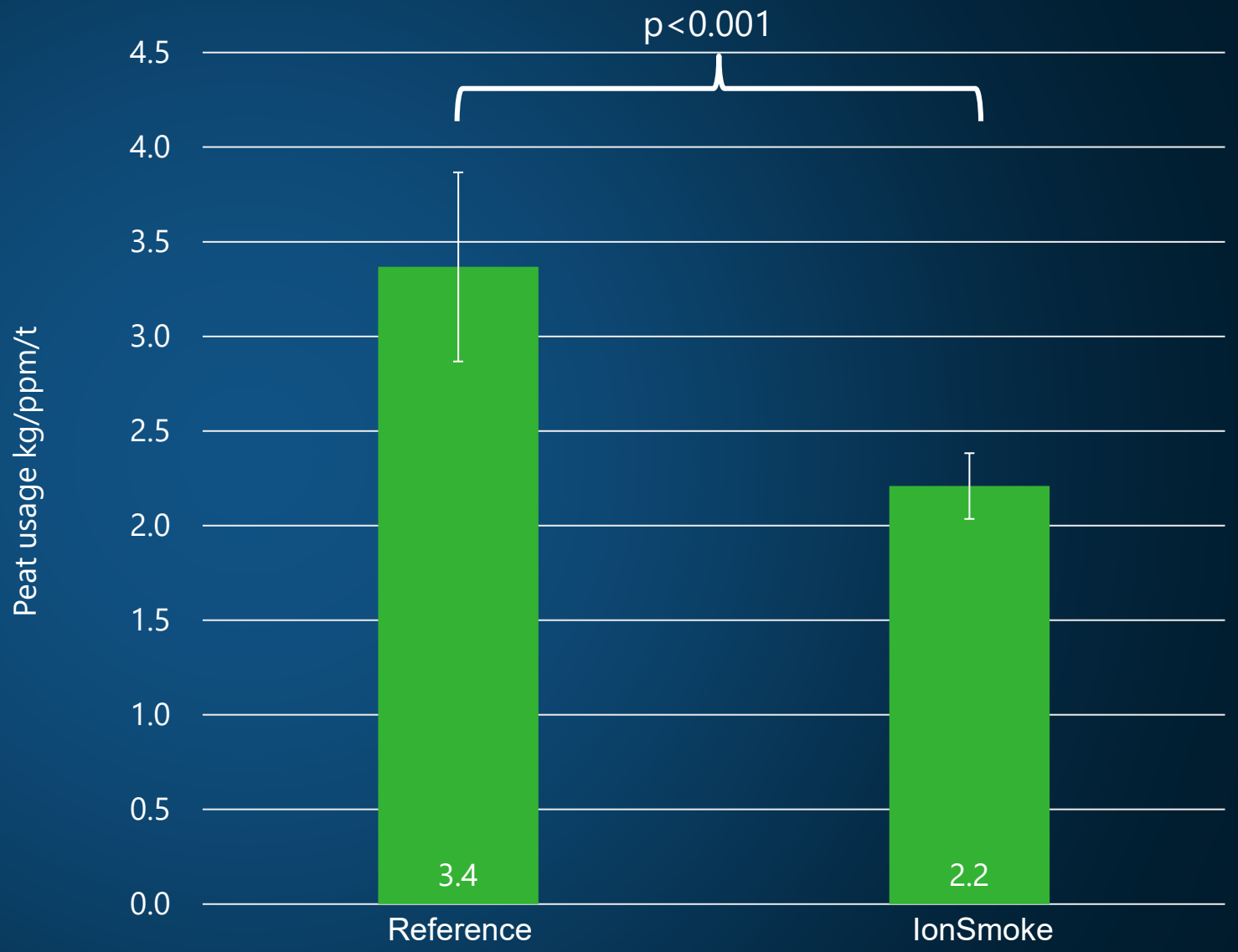


Decrease in peat usage

29.1-39.7% decrease in **mean peat usage** (CI=0.95)

The **standard deviation** decreased from **15%** to **8%**

This could equate to an **industry-wide peat saving** of **2200-3200t**.

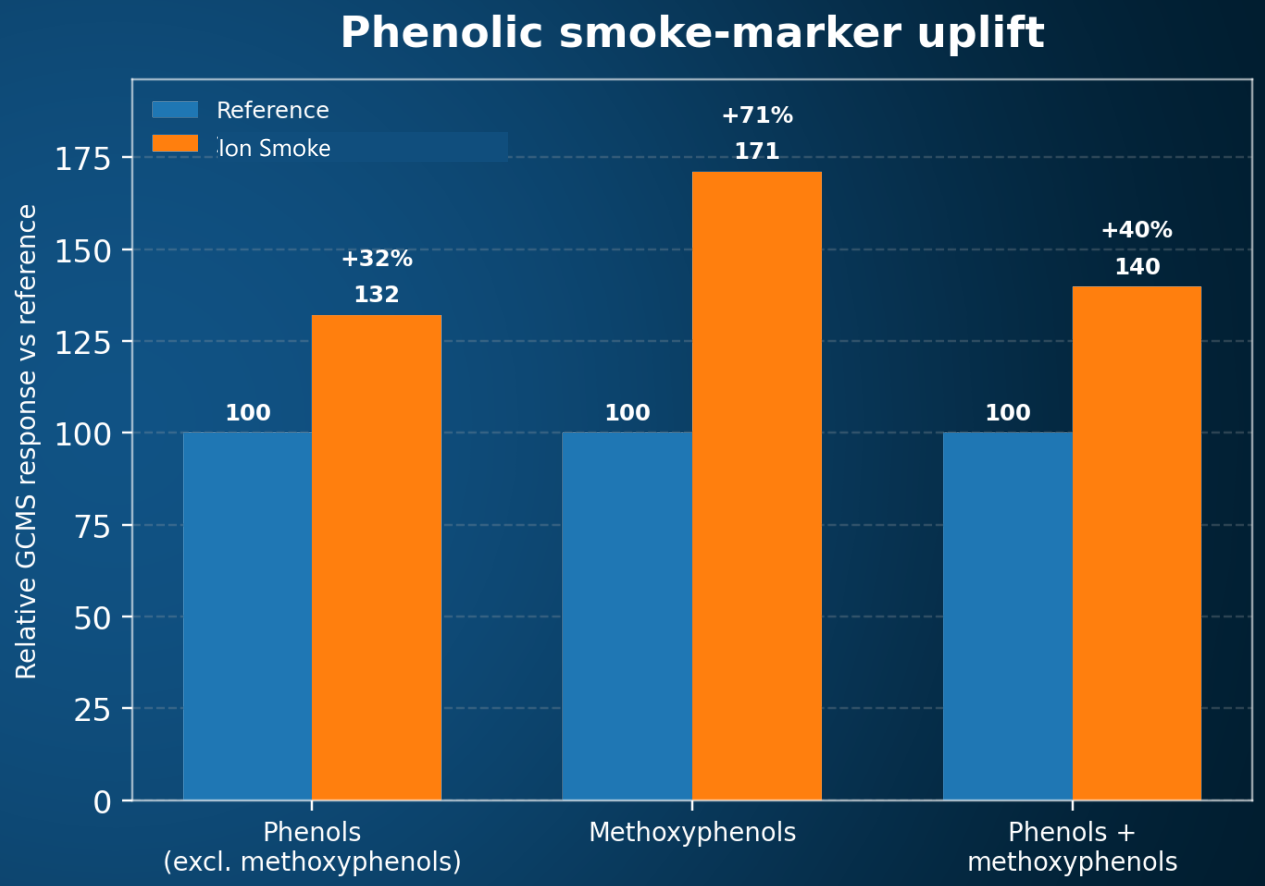


Higher phenolic smoke-marker uptake

SWRI completed GCMS analysis on the reference and ion-smoked malt samples.

Relative to the reference, ion-smoked malt showed higher phenolic smoke markers, including methoxyphenols.

The increase in phenolic smoke markers was observed without a corresponding increase in larger polyaromatic compounds of potential concern.



Industry Impact

If adopted across the malting industry, Ion Smoke could save 2,200–3,000 tonnes of peat every year.

Based on UK total peat use of 8,000 t/year (Scotch Whisky Association, 2024) and trial reduction of 29–40%.

2,200–3,000
tonnes of peat / year
(industry-wide adoption)

Peat saved annually
Equivalent to roughly 80–110 lorry-loads of peat each year.

1,800–2,500
tonnes of CO_2 avoided / year

Carbon emissions avoided
Roughly the annual carbon footprint of 250–350 average UK households.

~1,000
years to form
1 metre of peat

A non-renewable resource
Peat forms at just 1 mm per year — every metre we don't disturb is a millennium of formation preserved.

1 METRE OF PEAT

≈ 1,000

YEARS TO FORM

Standard rate for Scottish blanket bogs.

Next Phase: Scaling Up at Glenesk

50–60%

peat reduction vs. reference

Production-scale result with the 60 kV system

A clear step up from the 29–40% reduction observed in the original 30 kV trial — driven by both higher field strength and process optimisation.

↑ Scaled the system

- Doubled field strength: 30 kV → 60 kV at Glenesk
- Production install replacing trial unit
- Same kiln and malt programme, enabling direct comparison

✓ Validated performance range

- Production trials demonstrated **50–60% peat reduction** versus reference
- Performance achieved under defined operating conditions
- Further data is being collected to understand key process drivers

→ Building process understanding

- Reviewing drivers behind the **50–60% performance range**
- Building long-term operational reliability data
- Targeting consistent upper-range performance across batches

BOORTMALT IONSMOKED

Peated malt