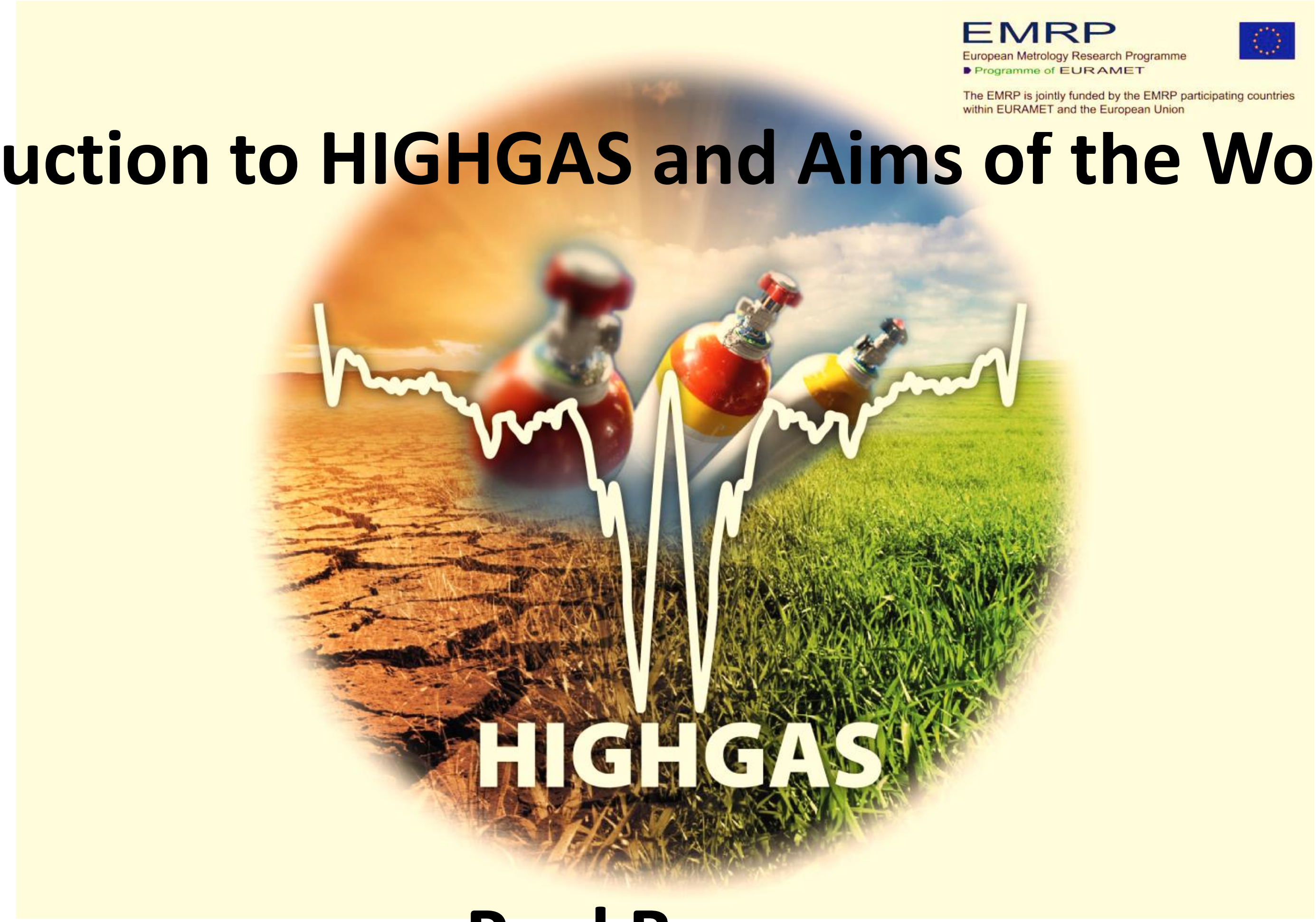
Introduction to HIGHGAS and Aims of the Workshop



Paul Brewer

LNE Paris

13TH November 2014

A brief history of climate change

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS

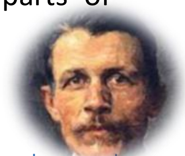
1824: Joseph Fourier describes the Earth's natural "greenhouse effect"

1861: John Tyndall shows that water vapour and other gases create the greenhouse effect

1886: Karl Benz unveils the Motorwagen

1896: Svante Arrhenius concludes that industrial-age coal burning will enhance the natural greenhouse effect

1900: Knut Angstrom discovers that even at the tiny concentrations found in the atmosphere, CO_2 strongly absorbs parts of the infrared spectrum



1938: Guy Callendar shows that temperatures and CO_2 concentrations had risen over the previous century, widely dismissed by meteorologists

1955: Gilbert Plass - doubling CO_2 would increase temperatures by 3-4 °C

1975: Wallace Broecker - "*global warming*" in the public domain

1987: Montreal Protocol agreed

1988: IPCC formed

1990: IPCC - temperatures risen by 0.3 - 0.6 °C over the last century

1992: Governments agree the United Framework Convention on Climate Change

1995: IPCC - "*a discernible human influence*" on the Earth's climate

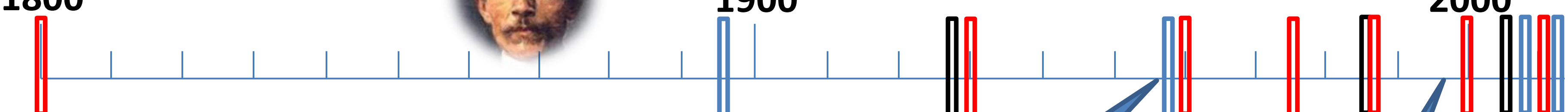
1997: Kyoto Protocol agreed

2001: IPCC - "*new and stronger evidence*" that humanity's emissions of greenhouse gases are the main cause of the warming seen in the second half of the 20^{TH} Century

2006: Stern Review - climate change could damage global GDP by up to 20% if left unchecked, but curbing it would cost about 1% of global GDP

2007: The IPCC: more than 90% likely that humanity's emissions of greenhouse gases are responsible for modern-day climate change

2012: Arctic sea ice reaches a min of 3.41 million km^2 a record for lowest summer cover



human population

1800: 1 billion
1930: 2 billion
1960: 3 billion
1975: 4 billion
1987: 5 billion
1999: 6 billion
2011: 7 billion

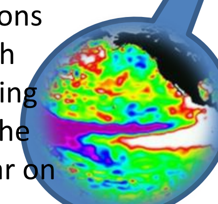
carbon emissions from fossil fuel burning and industry

1927: 1 billion tonnes per year
1986: 6 billion tonnes per year
2006: 8 billion tonnes per year

1895: CO_2 290 ppm
1958: CO_2 315 ppm
2008: CO_2 380 ppm
2013: CO_2 > 400 ppm

1958: Charles David Keeling begins systematic measurements of atmospheric CO_2 at Mauna Loa in Hawaii and in Antarctica

1998: Strong El Nino conditions combine with global warming to produce the warmest year on record



2013: IPCC - scientists 95% certain humans are "*dominant cause*" of global warming since 1950s

Rationale

EMRP
European Metrology Research Programme
Programme of EURAMET
The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS

- The measurement of greenhouse gases is pivotal to understanding changes in the Earth's climate
- National and international legislation is aimed at reducing greenhouse gas emissions which requires long-term measurements based on stable standards
- There is a significant requirement for **SI traceability**, as it provides the possibility for **more than one source** and will overcome supply issues, provides **coherence** and confidence through **international comparability**

HIGHGAS

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

- £3.5 M project
- 36 months (June 2014 – May 2017)
- Ten NMI partners: NPL, VSL, LNE, PTB, MIKES, DFM, FMI, CMI, METAS, TUBITAK
- Two Researcher Excellent Grants:

  Integral REG: Eidgenössische Materialprüfungs-und Forschungsanstalt (EMPA)
  Stage 3 REG: Radbound University (RU)

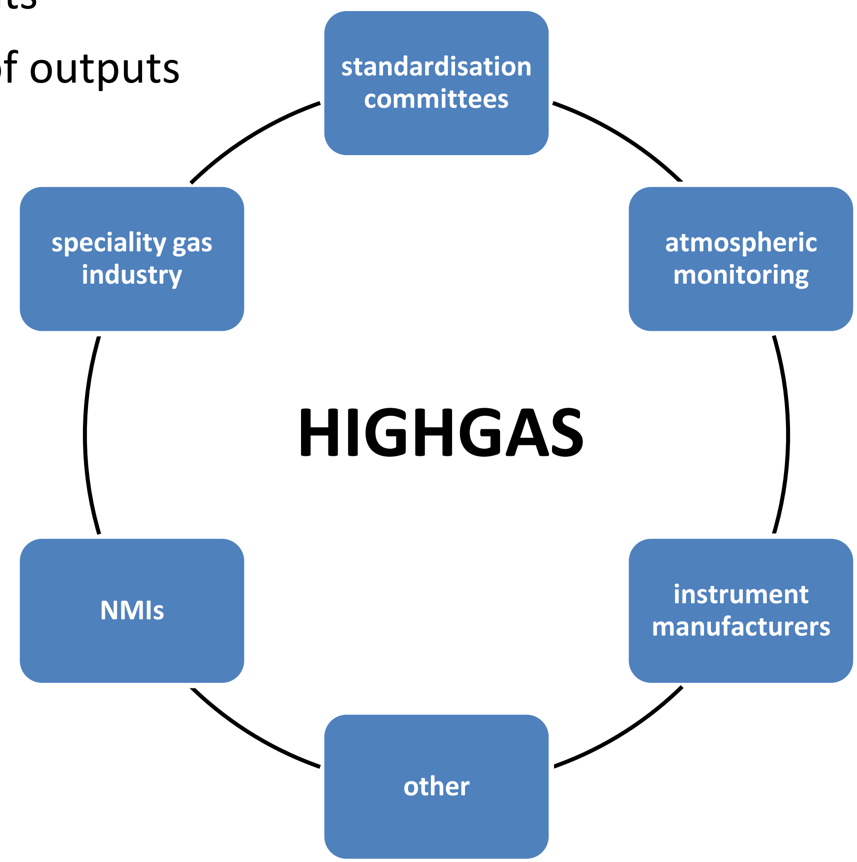
- Three technical work packages

Aims of the workshop

EMRP
European Metrology Research Programme
Programme of EURAMET
The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

Objectives:

- Engage stakeholders and outline JRP objectives
- Obtain input to steer the targets of the JRP
- Make contacts to represent the different communities
- Understand stakeholder requirements
- Discuss training and dissemination of outputs

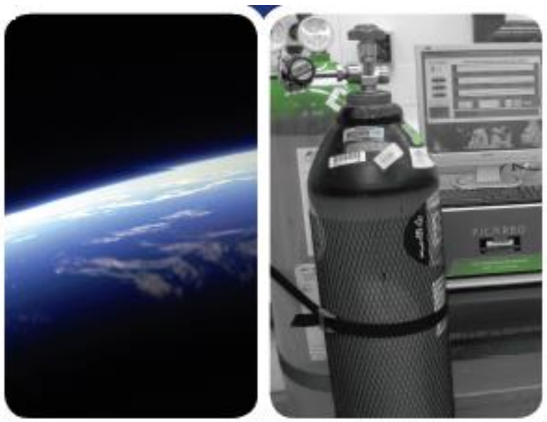


Beyond the state of the art

EMRP
European Metrology Research Programme
Programme of EURAMET

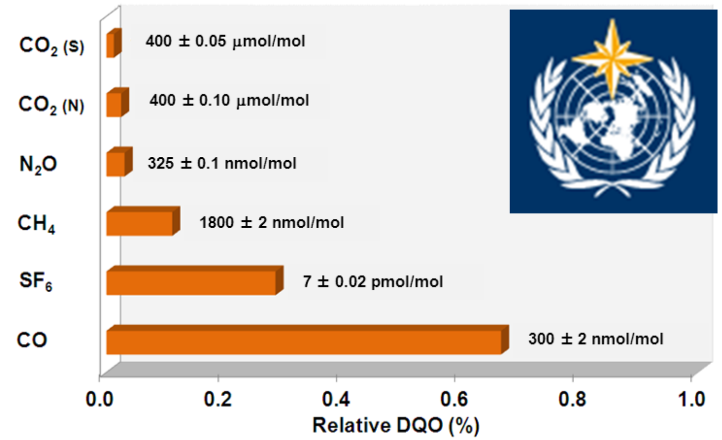
The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS



Disseminate reference standards:
stable
SI traceable
coherent
internationally comparable

target: WMO Data Quality Objectives



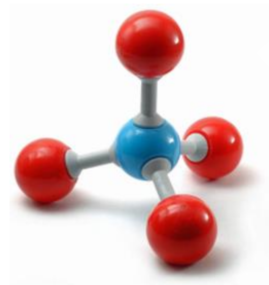
- Passivation chemistry to guarantee stability and accuracy over the timescales required
- Novel methods to quantify target components in the matrix gas
- Address systematic biases from instrumentation
- Portable calibration devices for dissemination to the field and reactive components
- Optical transfer standards based on laser absorption spectroscopy to validate field measurements
- Ratios of stable isotopologues to trace origin
- Accurate atomic weights for calculating amount fractions of gas standards

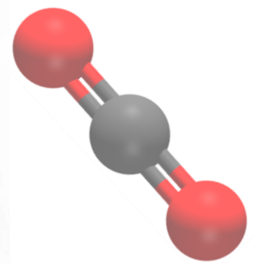
EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS

WP1:
High accuracy primary reference gas mixtures



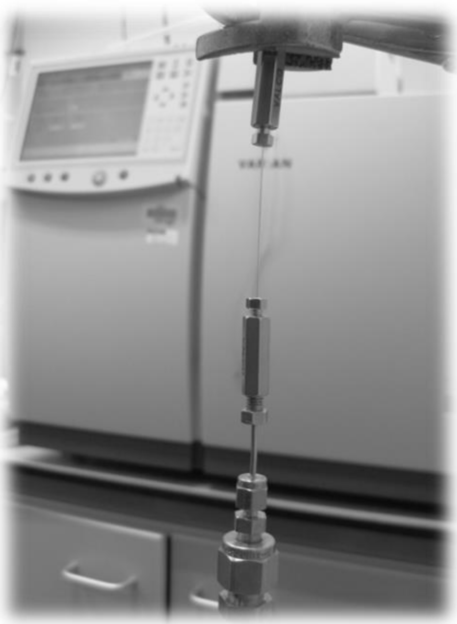


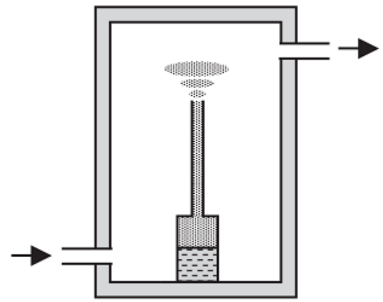
- Static reference standards (CO_2, CH_4, N_2O and CO) at unprecedented levels of accuracy and stability
- Investigation of systematic biases introduced from instrumentation at monitoring stations
- Assessment of the comparability of traceable reference standards to existing standards and scales

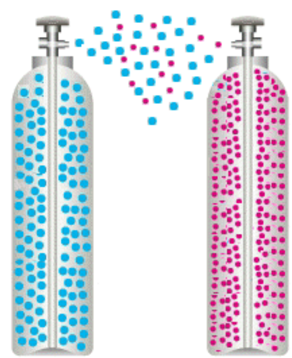
WP2:
Dynamic methods for trace amount fractions and dissemination to the field

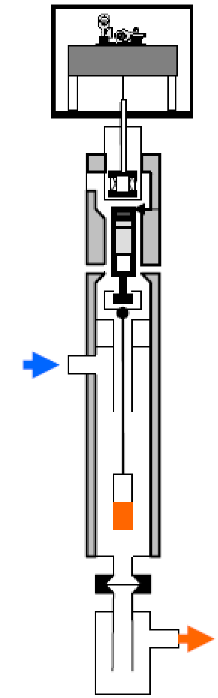
EMRP
European Metrology Research Programme
Programme of EURAMET
The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS







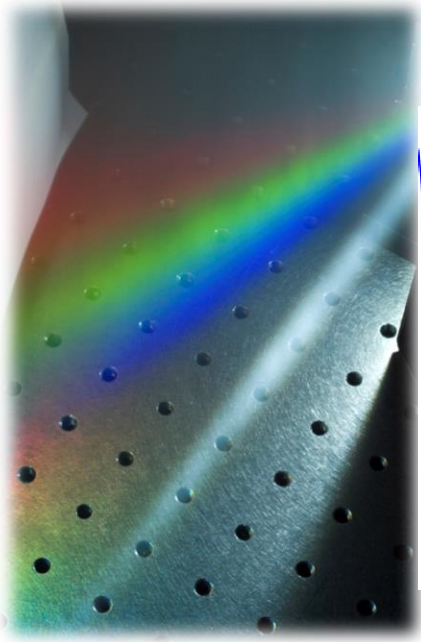


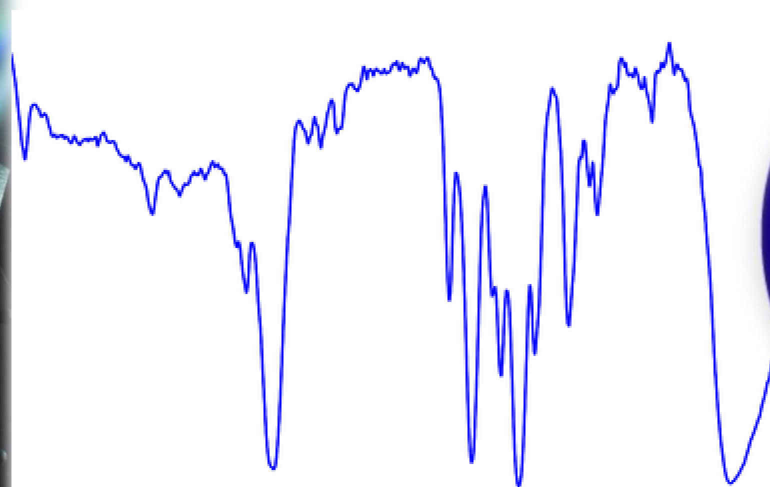
- High accuracy dynamic reference standards (CO and N_2O) for field calibration and validation of static reference standards
- High accuracy dynamic standards for F-gases (sub nmol/mol)
- Field dissemination and comparison to global scales for F-gases

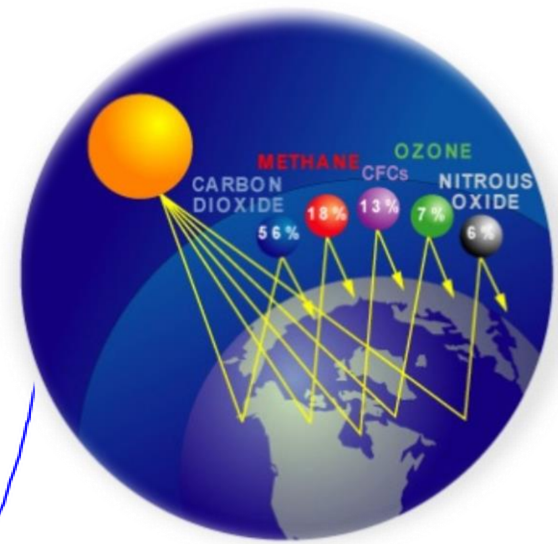
EMRP
European Metrology Research Programme
Programme of EURAMET
The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS

WP3:
Spectroscopic methods for isotopic composition measurements and transfer standards





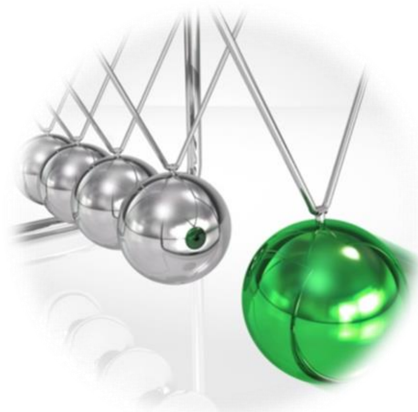


- Needs and potential impact of spectrometric gas metrology
- Complementary spectroscopy for high accuracy CO and CO_2 reference standards
- Isotope ratio measurements based on optical spectroscopy to support standards and determine origin

Impact

EMRP
European Metrology Research Programme
Programme of EURAMET
The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS



- Maintain stable values of greenhouse gases for analysis of trends in the atmosphere
- Underpin future data sets and the global capability for interpreting trends for improving our understanding of the influence of these components on climate change, air quality and human health
- Supply stable and accurate global data for global chemistry modelling
- Develop accurate benchmarks for evaluating the "state of the atmosphere"
- Transparent basis for developing and implementing policies for the control of anthropogenic emissions
- Defensible compliance with legislation (Kyoto Protocol, WMO/GAW programme, 2008/50/EC, 2001/81/EC, 2000/76/EC) and improvements in quality of life

Training and dissemination

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS

Develop and present technical training for end-users and stakeholders via 3 interactive webinars:

1 - Preparation of traceable, high accuracy static reference standards
2 - Novel dynamic systems to disseminate traceability
3 - Spectroscopic methods for transfer standards and measuring isotopic composition

- Webinar 1 will cover outputs from WP1 (NPL and VSL)
- Webinar 2 will cover outputs from WP2 (LNE)
- Webinar 3 will cover outputs from WP3 (PTB)

Workshop

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS

1 day workshop planned for M36 on new reference standards for high impact greenhouse gases

- To follow the final meeting
- To be hosted by NPL
- Involve stakeholders and JRP partners

JRP website

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS

Website includes:

- Information on the JRP
- Information on the JRP partners
- News and events
- Publications
- Results and presentations

http://projects.npl.co.uk/highgas/

Project meetings

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS

Month	Date	Meeting	Venue	Required
1	Jun-14	kick off meeting	NPL	All
5	**Nov-14**	**stakeholder meeting**	**LNE**	**WP leaders**
6	Dec-14	teleconference	-	All
9	Feb-15	WP leader meeting	EURAMET	WP leaders
12	May-15	teleconference	-	All
18	Nov-15	2nd project meeting	VSL/PTB	All
21	Feb-16	WP leader meeting	EURAMET	WP leaders
23	Apr-16	teleconference	-	All
28	Sep-16	3rd project meeting	PTB/VSL	All
33	Feb-17	WP leader meeting	EURAMET	WP leaders
36	May-17	final project meeting	NPL	All
36	May-17	stakeholder workshop	NPL	All

Stakeholders to be invited to second day of M18 and M28 meetings

Discussion Session

EMRP
European Metrology Research Programme
Programme of EURAMET
The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

HIGHGAS

How JRP will meet stakeholder requirements

- What are the main stakeholder requirements?
- What are the most important aspects of the project?
- What do you see as the most significant challenges in HIGHGAS?
- What are the most important emerging F-gases where new requirements exist?
- Is there interest to be involved in comparison exercises?

Training and future stakeholder engagement

- How best can we disseminate outputs from the project?
- What content would be beneficial in training modules?
- Additional requirements outside the project for future work?
- Future involvement in the HIGHGAS project?