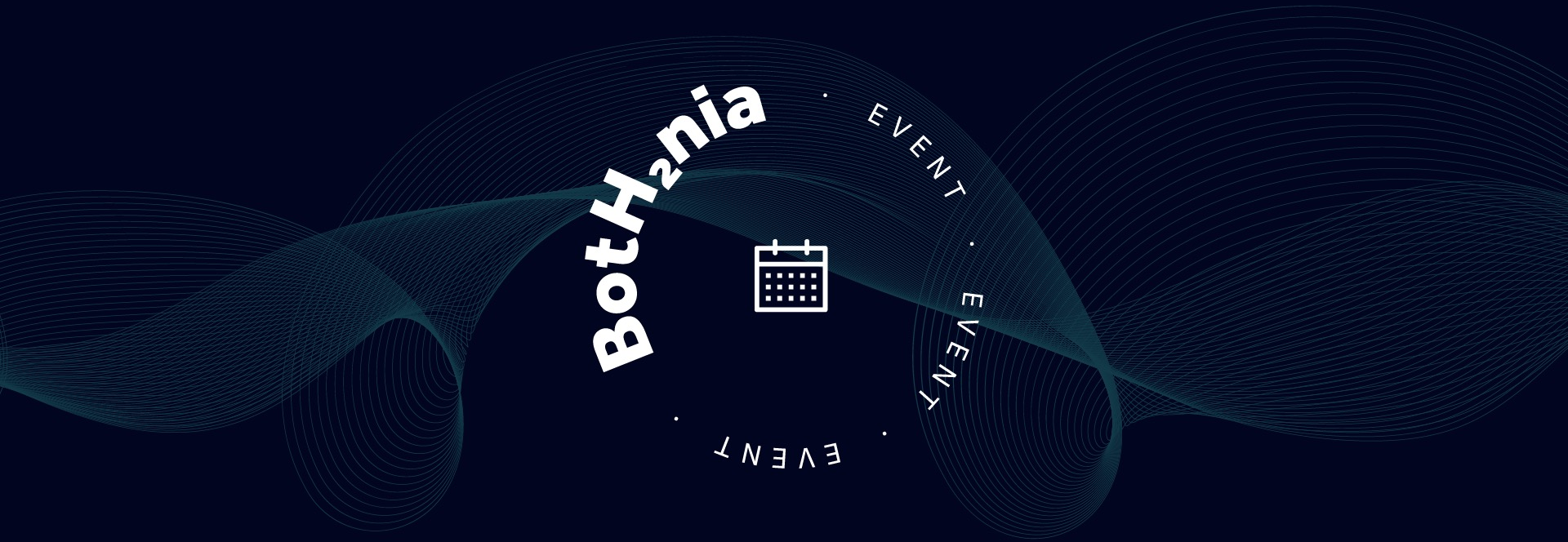
POHJOIS-POHJANMAA
COUNCIL OF OULU REGION



BotH$_2$nia goes Oulu & Raahe 5.–6.5.2022

This is a presentation given at the event Both$_2$nia Goes Oulu & Raahe on 5.–6.5.2022.

Both$_2$nia is a network of operators interested in hydrogen. The objective of the network is to create a Nordic hydrogen cluster around the Baltic Sea, beginning with the Bothnian Bay. Both$_2$nia strengthens the position of the north in the European hydrogen industry!

Both$_2$nia invites all businesses, research institutes, investors, municipalities and cities to roll up their sleeves for a greener future.

Please notice that the presentation has been modified to comply with the Accessibility Directive. In case for need the original material, please contact Minna Näsman (minna.nasman@both2nia.com).

We are Sweden’s research institute and innovation partner

New solutions for a sustainable future

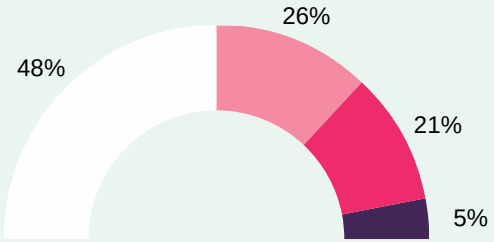
RISE is Sweden's vehicle for interdisciplinary innovation and change. Around 30 research institutes and approximately 130 test environments work together as an independent actor with a wide range of competences.

By collaborating as RISE, we can address the huge, complex challenges of our time. In doing so we become a driving force in the transformation of society and business.

International perspective

3396

Million SEK, net sales



Distribution of net sales

Business sector	1 632 MSEK
Public funds	874 MSEK
State funds	713 MSEK
EU funds	177 MSEK

Alla siffror avser 2020.

Founded in

2016

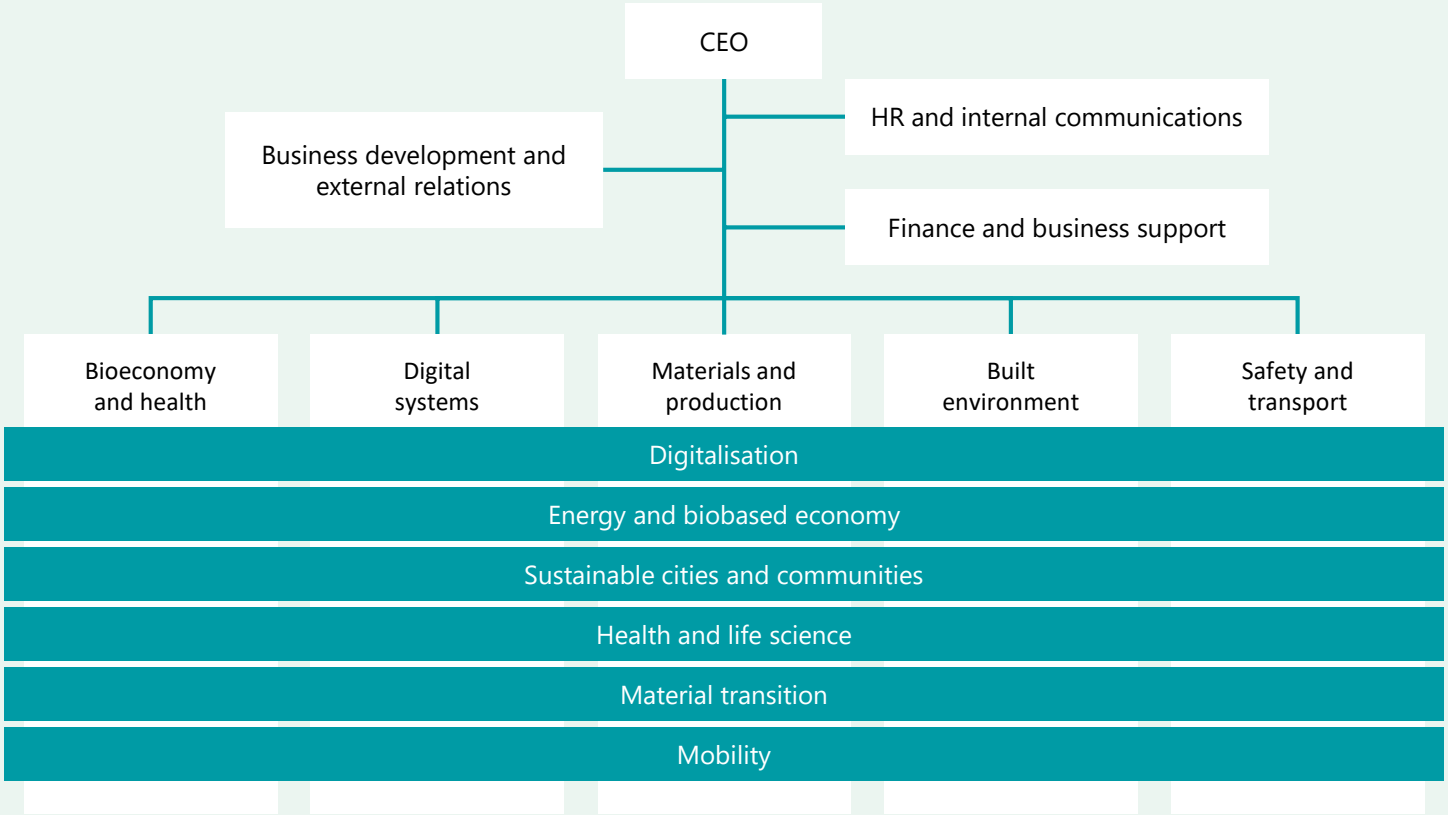
130+

Testbeds and demonstration environments

46

New patents in 2020

RI. SE


CEO
HR and internal communications
Business development and external relations
Finance and business support
Bioeconomy and health
Digital systems
Materials and production
Built environment
Safety and transport
Digitalisation
Energy and biobased economy
Sustainable cities and communities
Health and life science
Material transition
Mobility

Increasing competition for biogenic carbon

- Liquid/gaseous transportation fuels – aviation and maritime in large volumes also in a longer time perspective
- Renewable polymers/plastics and other materials – huge demand even with greatly increased circularity
- "Forest countries" have large sustainable biomass availability – forest industry residues
  - still limited compared to present fossil use
  - challenged by proposed EU directives
- Domestic energy and material supply of increasing importance
- Sustainability assurance easier for domestic feedstock supply chains

Biofuels production carbon efficiency

Produktionsteknik	C-eff.
Gasification – forest residues, BL	25-40%
and	40-55%
Ethanol 2G	~30%
Ethanol 1G	~40%
Bio gas	10-50%
HVO	50-90%

What limits carbon efficiency?

1. Composition of biomass feedstock is different from products
   - Biomass has H/C=1 and a lot of oxygen.
   - Product is typically hydrocarbon with H/C=2 and no oxygen
2. Biomass feedstock used to supply the energy for the process
   - Feedstock or intermediates often combusted to provide process heat demand
3. Undesired by-products formed
   - by side reactions and low selectivity

Can be mitigated by electrification

Take care of your biogenic carbon

- High carbon efficiency contributes to climate benefits and resource efficiency
- High carbon efficiency will be a clear competitive advantage in the longer term – perhaps even a requirement.
- Integrated electrification ("bio-electro-fuels") can provide drastically increased carbon efficiency for 2G biofuels
- Overall energy efficiency and production cost in general not influence much by electrification – improved carbon efficiency does not cost a lot
- Great potential for resource-efficient lignocellulose-based fuels and chemicals

The presentation is based on results from the project "Bio-electro-fuels – technology with potential for increased resource efficiency", funded by the Swedish Energy Agency and the f3 Swedish Knowledge Centre for Renewable Transportation Fuels.