



# Groeien met Groen Staal: TUDelft

Erik Vegter, programme director

# ‘Groeien met Groen Staal’

- Introduction
- The GGS programme
- Five GGS Themes
- Outlook



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# Addressing the issue

A wide-angle photograph of a cityscape under a heavy, overcast sky. In the foreground, there's a body of water and some greenery. In the middle ground, a dense urban area with several high-rise apartment buildings is visible. On the left side, a tall, dark industrial chimney stands out, emitting a thick plume of white smoke that rises into the sky. The overall tone is somewhat somber due to the grey clouds.

- 7% of total CO2 emissions of the NL
- Fine dust and other pollutants
- Extreme energy consumption
- Dependence on fossil fuels
- Depletion of resources
- Bad societal image
- Large amount of scrap and landfill

*Current method of steel production and use is not sustainable but demand increases*

# What are we heading for?

Climate  
Profit

Economic  
Profit

Human  
Capital

Resource  
Autonomy





# Vision after 8 years

2032

*The Netherlands will be in all aspects at the forefront of sustainable and circular steel*

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Door nog meer en slimmere recycling.

A close-up photograph of several parallel metal beams, likely steel, that are heavily corroded with rust. The rust is a mix of dark brown and reddish-orange, covering most of the surface. The beams are stacked or bundled together. A semi-transparent dark blue horizontal band is overlaid across the middle of the image, containing the title text.

# The GGS programme



# Program characteristics

8 years

45 projects

- Demonstration projects
- Knowledge development projects
- Education project

Budget 101

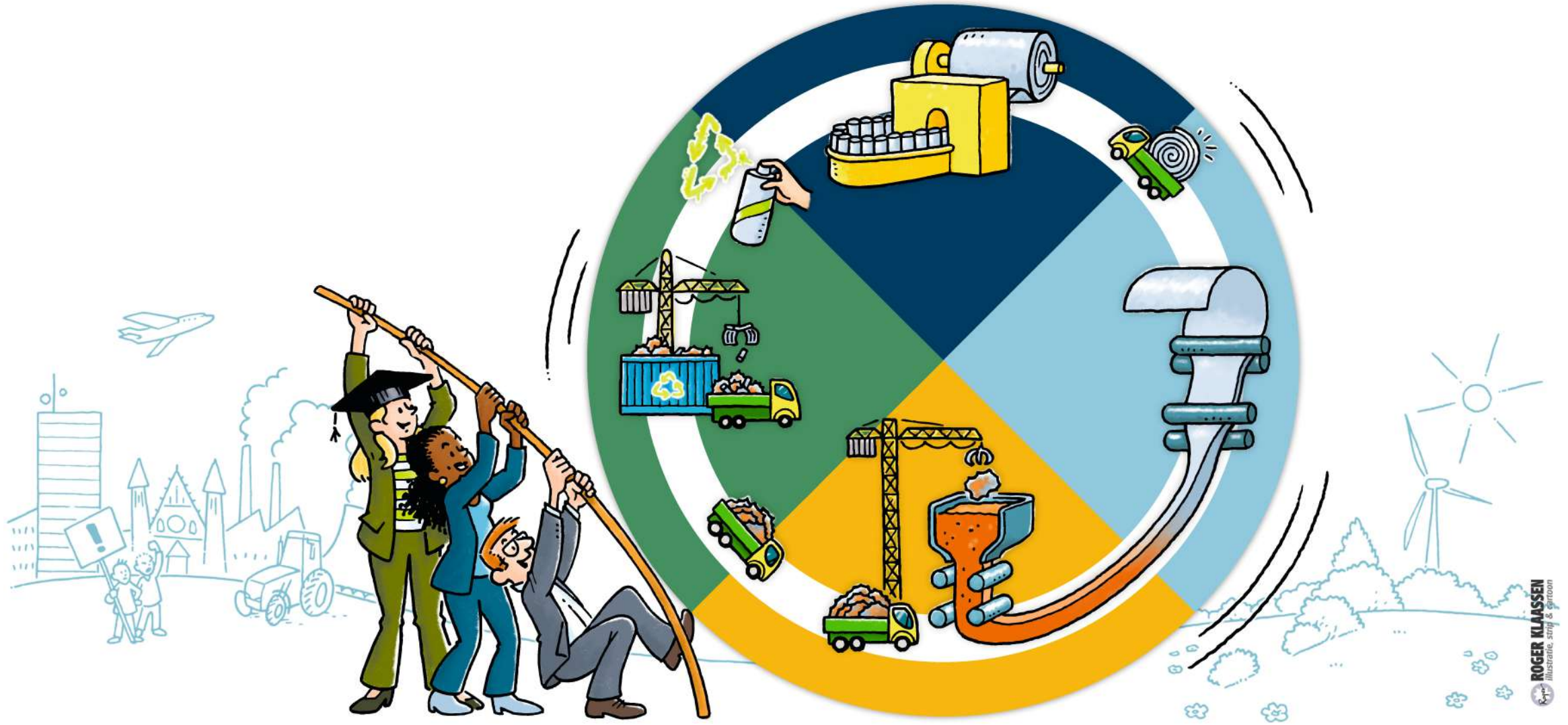
MEuro NGF

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# Themes



ROGER KLAASSEN  
Illustratie, stijl & ontwerp

# GGG Program committee

## Theme leads



Mar Pérez-Fortes  
(TU Delft)



Nitte van Landschoot  
(Tata Steel)



Maria Santofimia  
Navarro (TU Delft)



Jan Post (Philips/  
Rijksuniversiteit  
Groningen)



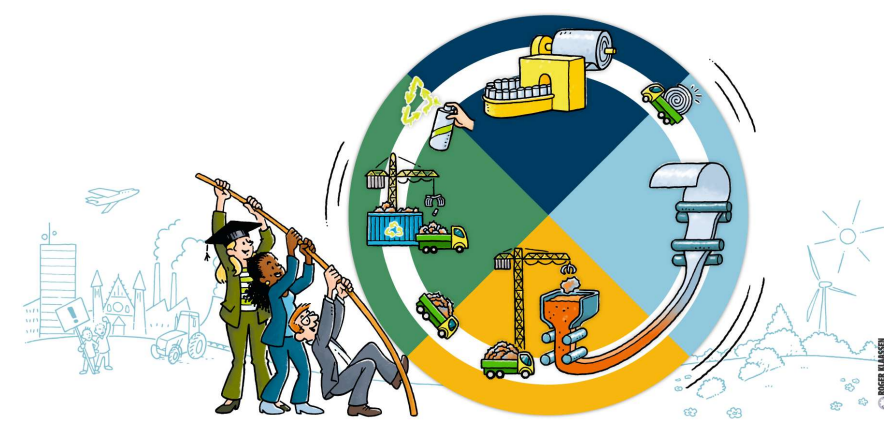
Pieter Kuiper  
(Auto Recycling  
Nederland/M2i)



Erik Vegter  
(SKF/M2i)  
Program director



# 5 themes



Theme lead: **Mar Pérez-Fortes**

Demonstration projects

I.1 Integration of results and recommendations  
**Wiebren de Jong // Niels Pulles**

Knowledge development projects

I.1 Factory level  
**René Kleijn // Mar Pérez-Fortes**

I.2 Value chain level  
**Niels Pulles // Erwin Hofman**

IV.3 Context level  
**Jenny Lieu // Ernst Worrell**

Theme lead: **Maria Santofimia Navarro**

Demonstration projects

III.1 Impurity tolerant design and processing of green steel <b>Rene de Vries</b>	III.2 Processing facility for assessing steel products hand-led thermo-mechanically using technologies based on hydrogen and electricity <b>Mustapha Bsbzi</b>	III.3 Upscaling strategies from the lab to industry: minimizing energy and critical resources through new processing routes and methods <b>Lie Zhao</b>	III.4 Online and offline digital twin models for green steel processing <b>Sebastian Echeverri Restrepo</b>	III.5 New coating design to prepare freshly coated steel for future scrap metal <b>Ruud Westerwaal</b>
III.1 Consequences of changes in primary production and in the inclusion of scrap metal in steel products <b>Jilt Sietsma//Yan Ma</b>	III.2 New sustainable processing technology and equipment and the impact on steel products <b>Kees Bos</b>	III.3 New steel types using energy-saving processing routes and minimising the presence of critical resources <b>Erik Offerman</b>		

Theme lead: **Pieter Kuiper**

Demonstration projects

III.4 Develop twin model for <b>Semih Perda</b>	III.5 Preparing input: the chal <b>Yutao Pei</b>	V.1 Scrap metal analysis in the steel industry <b>Frank Schrama</b>	V.2 Tin extraction in used steel cans <b>Arti Klaasen</b>	V.3 Recovery of maritime steel <b>TBD</b>	V.4 Bypassing smelting/steel production through 3D additive manufacturing <b>Frank Verouden</b>
V.1 Metallurgical model of scrap metal streams <b>Yongxiang Yang</b>	V.2 Smart recovery and separation of ferrous scrap metal <b>Dingena Schott</b>	V.3 Refining general scrap steel <b>Neslihan Dogan</b>	V.4 Processing scrap steel for reuse <b>Giulia Finotello</b>	V.5 Organisation of the ferrous waste landscape <b>Boriana Rukanova</b>	

Theme lead: **Nitte Van Landschoot**

Demonstration projects

II.1 DRI-test installation <b>Wico Verloop</b>	II.2 REF-test installation <b>Wico Verloop</b>	II.3 Modular gas treatment for CCU application <b>Koen Meijer</b>	II.4 Scrap metal smelting unit <b>Wico Verloop</b>
Knowledge development projects			
II.1 Development of H2-DRI on the basis of blast furnace quality pellets <b>Stefan Born</b>			
II.2 Carbonaceous Crude iron from DRI based on H2 <b>Ali Emami</b>			
II.3 Making liquid steel using fossil-free crude iron and increased scrap metal <b>Bapin Rout</b>			
II.4 Hydrogen based Hisarna for the long-term perspective <b>Koen Meijer</b>			
II.5 High-value scrap metal as a source for sustainable steel production <b>Frank Schrama</b>			
II.6 Advanced modelling and digital twins for the production of iron and steel on the basis of hydrogen <b>Vinod Dhiman</b>			

Theme lead: **Jan Post**

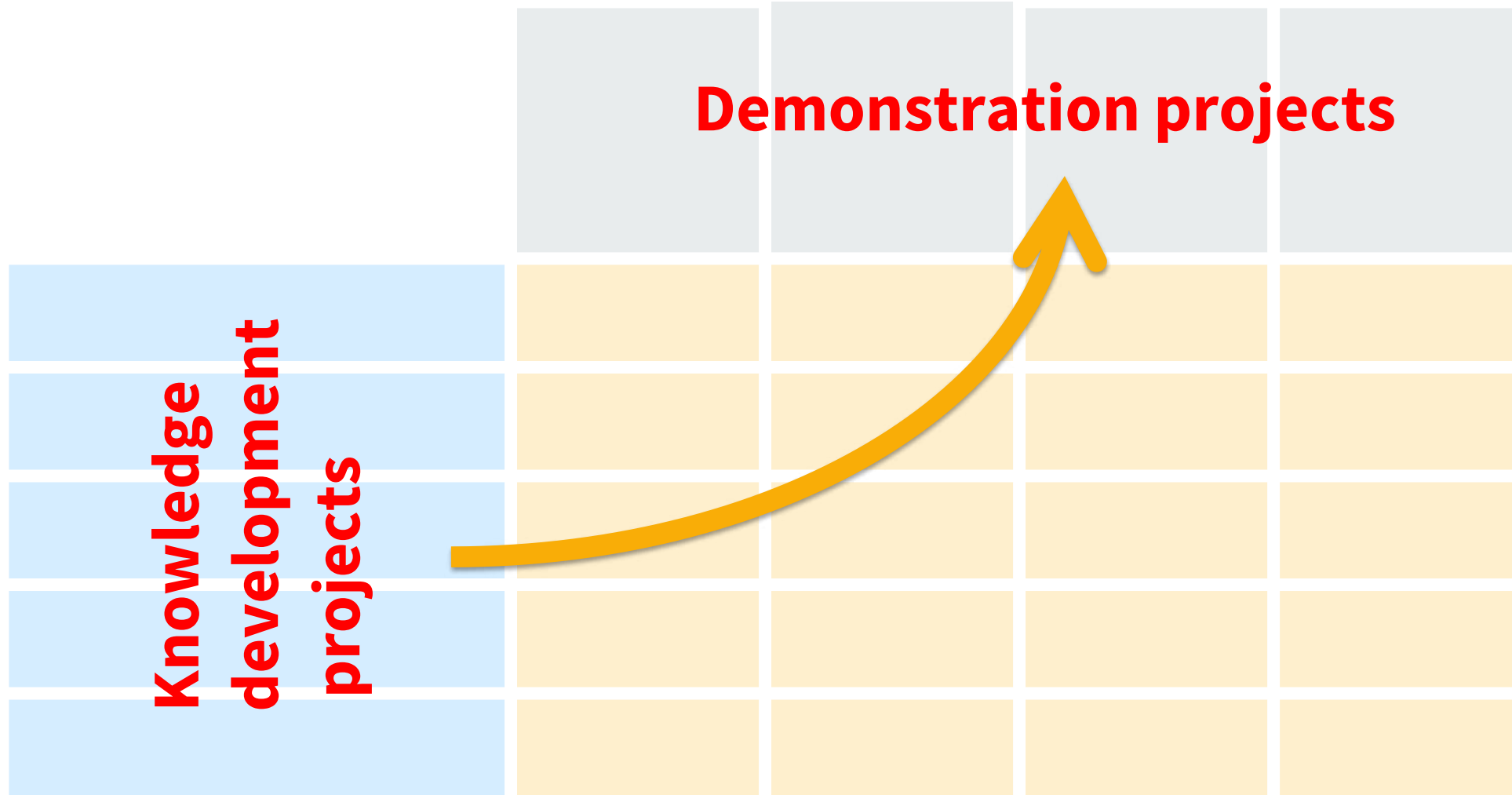
Demonstration projects

IV.1 Stainless steel for consumer products <b>Redmer van Tijum</b>	IV.2 Steel for car panels <b>Eisso Atzema</b>	IV.3 Durable high-strength steel for ball bearings <b>Pei Rose Yan</b>	IV.4 Sheets and profiles for use in constructions <b>Marije Deul // Joke Luyten</b>
Knowledge development projects			
IV.1 Definition of green steel in application <b>Joke Luyten // Kamiel Jansen</b>			
IV.2 Material properties as a function of change in the chemical composition because of recycling <b>Pei Rose Yan</b>			
IV.3 Development of a digital twin of the material for the purpose of predicting properties in usage <b>Marc Geers</b>			
IV.4 Reuse and properties <b>Mic Barendsz</b>			
IV.5 Robustness and control <b>Eisso Atzema</b>			

+ Education project

# Theme organization

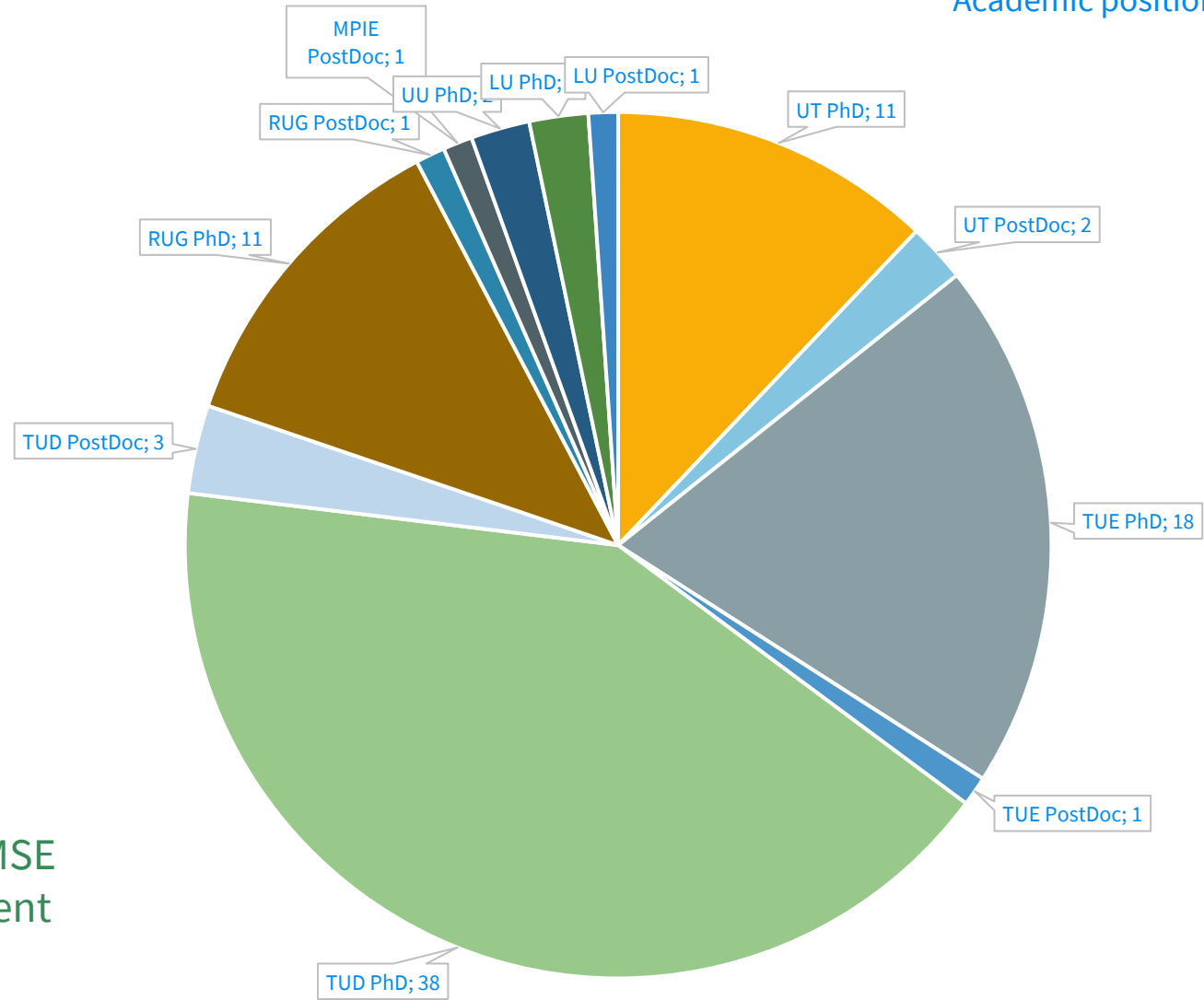
Theme lead





# Academic portfolio

Academic positions in GGS (May 2024)



TUD:  
Mechanical Engineering: mainly MSE  
Technology Policy and Management

The background image shows a vast industrial steel mill. In the center, a bright, glowing furnace or ladle pours molten metal, creating a stark contrast with the dark, blue-tinted steel structures. The scene is filled with complex machinery, pipes, and structural beams, creating a sense of scale and industrial activity. The lighting is a mix of the intense orange from the heat and the cool blue from the ambient mill lights.

# Five Themes



# Theme 1: System changes

Changes are needed all through the system

Theme 1 focusses on scenarios for the steel transition

- Factory level
- Value chain
- Context



# Thema 2: productie

Crucial research for the implementation of the Tata Steel Groen Staal plan, e.g. topics on:

- Hydrogen for Direct Reduced IronDRI
- Increased scrap use
- Reducing Electric Furnace



[www.tatasteelnederland.com](http://www.tatasteelnederland.com)



# Theme 3: processing

Green steel may require different processes

Processing of steel needs to be more energy efficient and green

- Heat treatment
- Digital twin/modelling processes
- Steel composition
- Coatings
- etc



# Theme 4: Use

Green steel will be used in many sectors:

- Automotive
- Components
- Building materials

Important subjects

- Properties
- Digital twins
- Remanufacturing/re-use





# Theme 5: Recovery

Scrap demand will rise. To cope with this projects are executed in the areas of:

- Scrap sorting
- Value chain modelling
- Scrap refininery
- Material passports
- Novel recovery methods



# Outlook

## We have started!

- Industrial demonstration projects are executed
- Academic research is starting
- Knowledge dissemination (education, communication) in preparation

*For information: [www.groeienmetgroenstaal.nl](http://www.groeienmetgroenstaal.nl)*





# Let's get the wheel move together

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