

20  
24

Holst Centre  
Executive Report

# Innovation for tomorrow

Driving economic  
competitiveness

“ We don't just want to maintain our position in the value chain. We want to grow it and become indispensable in it.”

Consider any pressing societal challenge today. Chances are, there's a chip at the center of the solution. From healthcare to climate change, from mobility to communication, next-generation electronics are essential to our society and economy.

As a world leader in low-power chips, Holst Centre demonstrated its value when our Channel Sounding technology became the global Bluetooth standard. Whether photonic, ultra-wideband, edge AI or otherwise, we design the chips that power our world, and the equipment that creates them.

Beyond chip design, we are a key player in hybrid printed electronics, circular electronics, and emerging markets like energy storage, integrated photonics and advanced packaging. Together with our partners, we enable innovations that meet societal demands and maximise economic growth.

Competition is fierce. We must claim our role in the design, manufacturing, and scalable production of these world-changing innovations. As part of a collaborative Dutch ecosystem, we aim to remain essential to the value chain. We enter the market, in part, through spin-off companies, such as TracXon, Keiron and FononTech. Through collaboration and support, we can help ensure that the world benefits from these critical technologies.

**Ton van Mol**

Director TNO at Holst Centre

**Kathleen Philips\***

Director imec at Holst Centre

*\*Jesse Robbers will assume the role of Regional Managing Director at imec NL, and will succeed Kathleen Philips in her role at Holst Centre as of 1 May 2025.*

# Table of contents

## Innovation for tomorrow

Driving economic  
competitiveness

<b>Introduction</b>	
<b>Facts and figures</b>	<b>7</b>
<b>2024 highlights</b>	<b>9</b>
<b>Technical highlights</b>	
Integrated photonics	13
Organ-on-chip	15
Bluetooth	17
Electrolysers	19
Precision health monitoring	21
Circular electronics	23
<b>Funded projects</b>	<b>25</b>
<b>Partnerships</b>	<b>27</b>
<b>Start-ups and spin-offs</b>	<b>29</b>
<b>Looking ahead</b>	<b>30</b>

# 20 Facts & 24 figures



34

**Collaborations** in the Netherlands



54

Total number of **partnerships**



196

**Dutch partners** within funded projects (EU and national)



55

Turnover (in M €)



56

Ongoing **funded projects**

10



Part-time **Professors**

52



**Master students & interns**

220



**FTEs**

8



**PhD students**

49



**Patent filings**

58



**Publications** (peer reviewed)

# 2024 Highlights

## 3D Printed Electronics

In 2024, TNO at Holst Centre achieved a key milestone in 3D printed electronics by developing a high-resolution proof-of-concept printing system, enabling the integration of complex electronic functions directly into 3D-printed structures. This innovation opens new possibilities for next-generation semiconductor packaging, free-form antennas, and miniaturized medical wearables, reinforcing TNO's position at the forefront of hybrid electronics manufacturing.

## ChipNL Innovation Program

ChipNL is a Dutch semiconductor consortium. In mid-2024, ChipNL called for public financing of €100–150 million per year over six years, totaling €600–900 million, to bolster semiconductor innovation in the Netherlands. As key contributors, TNO and imec are able to bring in world-class research capabilities to support the development of next-generation packaging technologies, boost chip design expertise, and facilitate industry-academia collaboration across the Dutch ecosystem.



## Scale-up: Axelera AI

In 2024, one of imec's spin-offs, Axelera AI (founded in 2021), secured €61.6 million in funding from the EuroHPC Joint Undertaking (JU) and member states to develop a scalable AI chiplet for high-performance computing. Axelera AI is a Netherlands-based AI semiconductor company, and this substantial investment will support the development of innovative Digital In-Memory Computing (D-IMC) architecture, enhancing Europe's competitiveness in the AI and semiconductor sectors.



## ChipNL Competence Centre

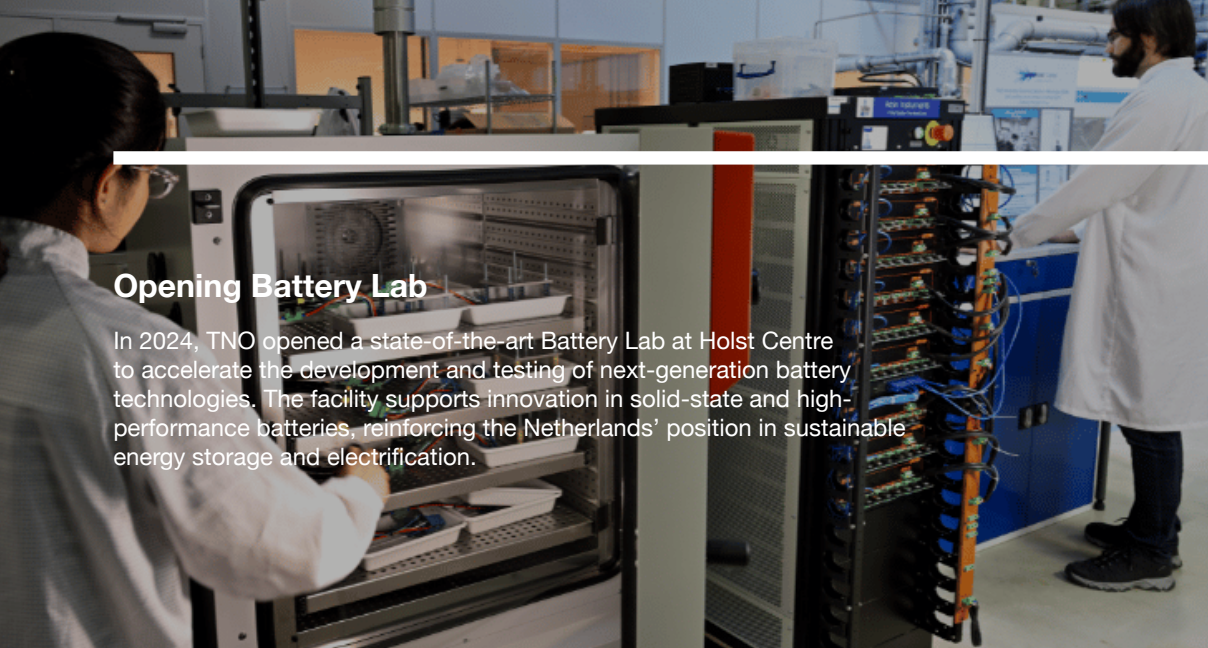
The ChipNL Competence Centre is established within the framework of the EU Chips Act to accelerate innovation and collaboration within the Dutch semiconductor landscape. With TNO and imec as founding knowledge partners, the centre provides strategic support to companies and research institutes in areas such as heterogeneous integration, advanced packaging, and system/circuit design.

Learn more about  
ChipNL Innovation  
Program



Learn more  
about ChipNL  
Competence Centre





## Opening Battery Lab

In 2024, TNO opened a state-of-the-art Battery Lab at Holst Centre to accelerate the development and testing of next-generation battery technologies. The facility supports innovation in solid-state and high-performance batteries, reinforcing the Netherlands' position in sustainable energy storage and electrification.

## Holst Centre Innovation Day 2024

At Innovation Day 2024, Holst Centre brought together 470 visitors from across industries to explore how dynamic, open collaboration can accelerate innovation where it's needed most. In a world facing rapid societal transitions, the event underscored that true impact is created not in isolation, but through agile ecosystems working together across the value chain.



Watch the Innovation Day aftermovie

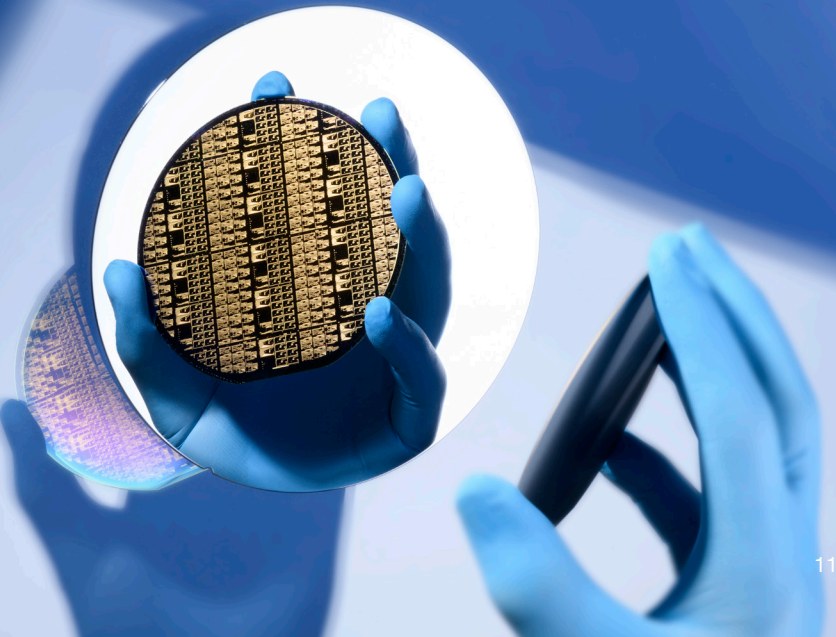


## Pilot Line 5 Photonics

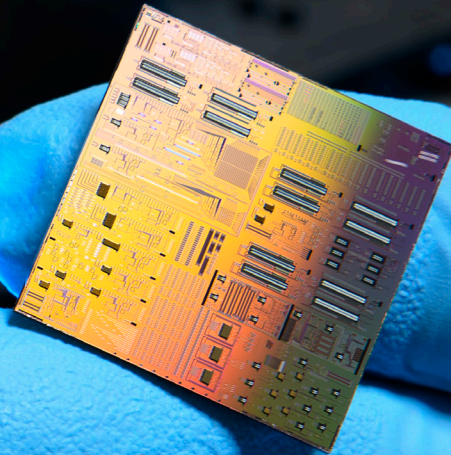
Under the EU Chips Act, which aims to boost Europe's semiconductor capacity and technological sovereignty, Pilot Line 5 focuses on integrated photonics—using light for faster, more efficient data processing. As a key partner in the PIXEurope consortium, TNO at Holst Centre contributes its expertise in design, prototyping, and process integration to help establish cutting-edge photonic chip production facilities in the Netherlands.



Learn more about PIXEurope



# Integrated photonics



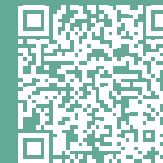
“ Holst Centre is a valued and strategic partner for PhotonDelta. Their collaborative innovation model, where shared IP accelerates journeys from idea to impact, is unique. With a strong international network and deep ecosystem involvement — including active participation in, e.g., PIXEurope and PITC — they are a driving force in bringing advanced technologies to market faster.”  
– Eelco Brinkhoff, CEO, PhotonDelta

## Accelerating the application of integrated photonics

Even state-of-the-art electronic chips don't offer the bandwidth needed to support our future. From AI to sensors, from new healthcare innovations to data security and from LiDAR to advanced communication, Photonic Integrated Circuits (PICs), or photonic chips, offer higher bandwidth, functionality, and speed, all with lower energy usage.

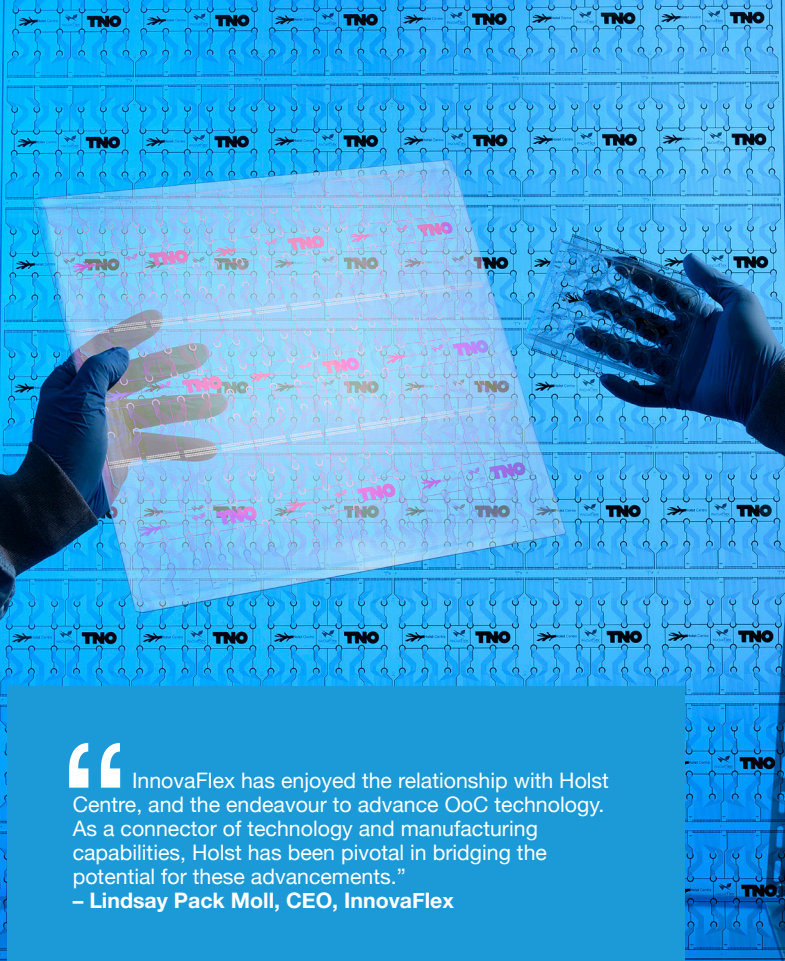
Every PIC is uniquely tailored to its intended application. Each application requires the right integration of traditional silicon, silicon nitride, and indium phosphide material platforms in order for the chips to perform optimally.

Holst Centre not only designs PICs, but also partners closely with ecosystem stakeholders to develop the unique and targeted production processes and equipment that enable scalable, high-volume production. All to ensure the Netherlands remains at the centre of PIC design, manufacturing, integration, and application.



Learn more about Integrated photonics at Holst Centre

# Organ-on-chip



“ InnovaFlex has enjoyed the relationship with Holst Centre, and the endeavour to advance OoC technology. As a connector of technology and manufacturing capabilities, Holst has been pivotal in bridging the potential for these advancements.”  
– Lindsay Pack Moll, CEO, InnovaFlex

## Scalable and cost-effective organ-on-chip technology

Organ-on-chip (OoC) technology is set to revolutionise the healthcare industry. The technology more closely mimics human physiology, and leads to swifter drug discovery, drug development without animal testing, and even personalised medicine.

Holst Centre is developing innovations that will drive this revolutionary technology. We design the intricate electronics and sensors that enable in-line measurement of biomarkers. We also develop standardised systems that will make OoC scalable and cost-effective, leveraging flat-panel display technology that allows 50 well-plate modules to be produced on a single Gen 4.5 panel - for a 50% cost reduction.

The Netherlands is among the world leaders in OoC technology development. Together with multiple academic and industry partners, Holst Centre aims to create a key control point in the market application of this technology.



Learn more about  
OoC at Holst Centre

Technical highlights

# Bluetooth



“ Bluetooth 6.0 exists because of our expertise in Channel Sounding technology. It’s a solution with far more accurate location awareness, better security, and maximum flexibility in ranging without the need for extra chipsets in devices.”

– Jac Romme, Senior Researcher, Holst Centre

## Founding new global standards

Since 2005, Holst Centre has been contributing to Bluetooth technology. Our countless patents and innovations are part of the Bluetooth story. Today, Holst Centre’s Channel Sounding technology – which enables location awareness – led to a new global standard: Bluetooth 6.0.

What’s more, our expertise in Bluetooth Low Energy (BLE) contributes to developments in this energy-efficient Bluetooth ‘extension’. Designed for low-power, battery-operated devices, BLE connects IoT devices from wearables to smart homes, and from industrial sensors to connected health devices.

By contributing our expertise in Bluetooth hardware and software, and our understanding of market needs, Holst Centre ensures that our IoT future is connected, energy-efficient, and powerful. It positions us firmly as a recognised contributor to the Bluetooth value chain, and a world leader in Bluetooth technologies.



Read more about  
Bluetooth Low Energy

# Electrolysers

“ Our patented NovaPTL® technology, longer-lasting components, and processes that use 200 times less iridium are just some of the ways Holst Centre is making electrolysers far more efficient.” – **Oscar Díaz Morales, Programme Manager, High-Tech Electronics, Holst Centre**

## Global contributors to green hydrogen

Hydrogen plays a key role in our energy future. But the electrolysers used to produce, transport, and store green energy are expensive and inefficient, and rely on large quantities of critical raw materials (CRMs). Yet global installed capacity needs to increase by a factor of 25,000 by 2050.

Holst Centre already has registered trademarks and patented components that will help the Netherlands claim its position in global green hydrogen production. Our unique thin-film technology and advanced manufacturing techniques are driving innovations in next-generation electrolysers that are more efficient and use exponentially less CRMs.

Through spin-offs and collaborations, Holst Centre is enabling strong advancements in electrolyser design, key components for operation, and higher performance at lower costs, and can help position the Netherlands as a world leader in this technology.



Find out how Holst Centre is contributing



# Precision health monitoring

“Holst Centre holds all ingredients to bring this novel solution to industry, combining photonics, IC design, and biomedical expertise in one unique environment.”  
– Jesse Kling, Electronics Systems Designer, Holst Centre

**2.5x** | higher signal-to-noise ratio (SNR) than state-of-the-art optical sensors.

## Optical sensing technology

Wearables and medical devices use photoplethysmography (PPG) to monitor vital signs, such as heart rate, oxygen levels, and respiration. But PPG can be influenced by ambient light, and is notoriously inaccurate in patients with darker skin.

Holst Centre is improving patient care and driving innovation with speckle plethysmography (SPG), an optical sensing technology that addresses both issues. Our patented solution outperforms state-of-art sensors and will enable reliable monitoring of more complex biomarkers, like blood pressure. It also enables contactless monitoring to increase patient comfort and unburden care providers.

Our expertise in hardware, integrated photonics (PIC, ASIC), algorithms, and clinical validation drive the next generation of non-invasive medical devices. To make SPG more broadly applicable, we are miniaturizing components and optimising their performance and energy use.



Read more about  
precision health monitoring

Technical highlights

# Circular electronics

**95-97%** | plastic yields from the circular-by-design solution

**100%** | semiconductor yields from the circular-by-design solution

## The first circular-by-design in-mold electronics

In-mold electronics (IME) offer form freedom for attractive and user-friendly control panels in automobiles, appliances and devices. However, the electronics are fully encased in plastic, so their repair and end of life are a major challenge.

Holst Centre partnered with TactoTek, in-mold structural electronics (IMSE™) creators, to make IMSE parts the first truly circular electronics devices. With new methodologies and materials, TactoTek and Holst Centre are making IME and IMSE repair and recycling a reality.

Holst Centre has already tested design-for-recyclability IME, following automotive industry standards. We have also recycled IME and proven repair feasibility.

Working with the entire production, manufacturing and recycling value chain, Holst Centre and TactoTek are exploring ways to drive IME and IMSE repair and recycling solutions towards market realisation for multiple applications.



Learn more about this pioneering collaboration

# Funded projects

2024 shaped up to be a great year for Holst Centre, with over 40 funded research and innovation projects in motion. Here's a quick look at three of our latest ones.

## NEHIL

As part of a strategic collaboration between the EU and the Republic of Korea (ROK) initiated by the Chips Joint Undertaking (Chips JU), imec is leading the NEHIL Project. The project's aim is to advance FMCW LiDAR technology through neuromorphic architectures and advanced integration. Through collaborations like these, Chips JU aims to advance semiconductor research, development, and innovation to enhance supply chain resilience and secure a leading position in the global semiconductor industry.

The NEHIL Project is developing two key computing systems: FeFET-based Compute-in-Memory accelerators that enhance real-time processing, and photonic reservoir circuits for efficient dynamic data handling. When integrated into FMCW LiDAR, these developments will improve resolution, accuracy, and cost-efficiency, while reducing power consumption in object recognition by 50%.

## ECOTRON

In 2022, Holst Centre formed a consortium for EU H2020 project ECOTRON that aims to minimise the environmental burden of electronics through innovative technologies, new materials and processes for circular, recyclable and bio-based electronics. Among its industrial partners are Signify, BD, Johnson & Johnson and Polar.

An astounding reduction of environmental burdens was demonstrated for not just one, but for four use cases, namely lighting, drug delivery systems, smart packaging and wearables. As such, ECOTRON convincingly demonstrates that hybrid and printed electronics are a responsible alternative to conventional circuitry boards that form the basis of our electronic devices today.

## I3-INSHAPE

Through the Workplace Vitality Hub ([workplacevitalityhub.nl](http://workplacevitalityhub.nl)), Holst Centre aims to support SMEs to form international collaborations in the I3-INSHAPE project ([www.i3-inshape.eu](http://www.i3-inshape.eu)). By working together, SMEs can help to bring successful, innovative products and services to the market. These initiatives all have a common objective: combat inactivity and shift mindsets towards care of health instead of healthcare among the European population.

SMEs hold the key to solving inactivity among the EU population. They drive change from the bottom up, and offer products and services that most directly meet the needs and expectations of local populations. Their innovations in the Sports & Vitality market can not only improve citizen's health and well-being, but foster economic growth and strengthen interregional collaboration throughout Europe. Together with its partners in ELIS ([elisinnovationhub.com](http://elisinnovationhub.com)), Holst Centre supports this initiative to drive innovation and acceleration of viable solutions.

## Funded projects

UNLOOC  
DistriMuSe  
DAIS  
LEARN  
REBECCA  
CoRaLidar  
SuperIoT  
Biocurity  
E-Construct  
Kidnew  
PreventCKD  
LoLiPop  
NerveRepack  
NeuroKit2E  
STIMULUS  
Vital  
RealCare  
SpikeZip  
INSHAPE  
ICare4CVD  
LadyWise  
Nehil  
REMPower  
TIRAMISU  
EU-Trains  
UNICORN  
ECOTRON  
SUBLIME  
HyperStripes  
TREASURE  
HELENA  
Cleanhypro  
CIRCUITS  
SUSTRONICS  
NEWLIFE  
3DOP  
MID4automotive  
Persimmon  
Photonmed  
Sonoskin  
Dolores  
OpZuid Bloeddrukmeting

# Partnerships

ADI

LIONVOLT

tma

SPARKNANO

Leesman®

CTOUCH®

MED<sup>9</sup>EL

z e n s

ahrend

itec  
Bright in printing

Valeo

PACKETCRAFT®  
WORLD-LEADING WIRELESS

JK

RAPID PHOTONICS

Lohmann  
The Bonding Engineers

SONY

紫光同芯  
TONGXIN MICRO

nemho  
next material house

M MAAS  
TREAT YOURSELF WELL

RE2ET  
YOURSELF

SWP.

GlobalFoundries

FITTAR

OSRAM

ONVZ

PHILIPS

BEYOND EYES

TSC The Surgical Company

ShinEtsu

GE Healthcare

CXsemi

RENESAS

Kinly

COMPASS GROUP

TACTOTEK

# Start-ups and spin-offs

LIONVOLT tracXon

AMSYSTEMS

TOUCHWAVES KEIRON

SPARKNANO

LIFESENSE  
GROUP

FononTech

AXELERA  
ARTIFICIAL INTELLIGENCE

onera

bloomlife

AIKON



“ Looking ahead, we see real momentum in PIC design, growing interest in photonics-based applications, and more need for system design and engineering. Collaboration and innovation become increasingly important as we shape the future of technology. As part of this evolving landscape, we remain committed to working with our partners to explore new possibilities and driving meaningful impact.”

**Kathleen Philips and Ton van Mol**



Read our  
disclaimer

## Contact

**Holst Centre**  
+31 40 27 74 000  
[contact@holstcentre.com](mailto:contact@holstcentre.com)  
[www.holstcentre.com](http://www.holstcentre.com)

High Tech Campus 31  
5656 AE Eindhoven  
The Netherlands

P.O. Box 8550  
5605 KN Eindhoven  
The Netherlands



Established in 2005 by imec and TNO, Holst Centre is located at the heart of High Tech Campus Eindhoven. It features a 250-strong team of innovative minds (comprising 30 nationalities) that is deeply rooted in the 'Brainport' ecosystem of high-tech companies, all while being part of a unique international partner network. And it is committed to nurturing entrepreneurship and kick-starting promising technology start-ups. Its robust partnerships span across industry, government, academia, and educational institutions, bolstering the Dutch industrial landscape while creating societal impact.