Progress on sCO_2 Projects at KTH

Supercritical CO_2 Energy Technologies Symposium

Pittsburgh, USA - March 3, 2026

KTH Energy Department

Prof. Rafael Guedez, Head of Unit

Dr. Emily Fricke, Postdoctoral Researcher

Education for the future

KTH is Sweden's largest and oldest tech university

18,000 students

2,300 international

> 35% women

4,000 staff

336 professors

> 60% in research

Excellent research

28 Departments for applied and basic research

Focus: Sustainable and secure societal development

QS WORLD UNIVERSITY RANKINGS
Mechanical Engineering 2026

1 Nordics

5 EU27

25 World

Energy Department

Heat and Power Technology

- Applied research in collaboration with industry, universities and research centres
- Leveraging unique computational and lab infrastructure
- MSc. in Sustainable Energy Engineering
  PhD in Energy Technology
- Active in +25 EU and national funded projects

Swedish Energy Agency

Supercritical CO_2 research at KTH-HPT

SCO2OP-TES	COMHPTES	powder 2 power	HYBRIDplus		SHARPsCO	SOLAR sCO2OL
2024–2028	**2024 - 2027**	**2023–2027**	**2022–2026**	**2024-2027**	**2022–2025**	**2020–2026***
WP leader	Coordinator	Task leader	WP leader	Coordinator	Coordinator	Co-Coordinator
Pilot TRL5	Pilot TRL5	Demo TRL7	Pilot TRL5	Pilot TRL5	Pilot TRL5	Demo TRL7
~100 kW sCO2 demo	**~100 kW sCO2 demo**	**sCO2 cycle modeling**	**sCO2 cycle modeling**	**sCO2 cycle modeling**	**50 kW air-sCO2 HEx**	**~2 MW sCO2 demo**
sCO2 HP Carnot Battery	**sCO2 HP Industry**	**Solar (CSP) + sCO2**	**Solar (CSP) + sCO2**	**Solar (CSP) + sCO2**	**Solar (CSP) + sCO2**	**Solar (CSP) + sCO2**
MS + solids (< 350 C)	TBD (<350 C)	Particles (< 800 C)	MS + PCMs (< 600 C)	Air + solids (< 800 C)	Air + solids (< 800 C)	Molten Salts (< 600 C)
~5 M€	~3 M€	~5.3 M€	~3 M€	~3 M€	~3 M€	~10 M€

SCO2OP-TES
Project Overview

SCO2OP-TES

Horizon EU Project GA # 101136000

Main Objective:

To validate a 100 kW sCO2 based P2H2P pilot

New components to TRL5 (Pilot):

- TES (molten salt + slags thermocline)
- sCO2 turbomachinery and Molten Salt – sCO2 HEx

Time-plan and budget :

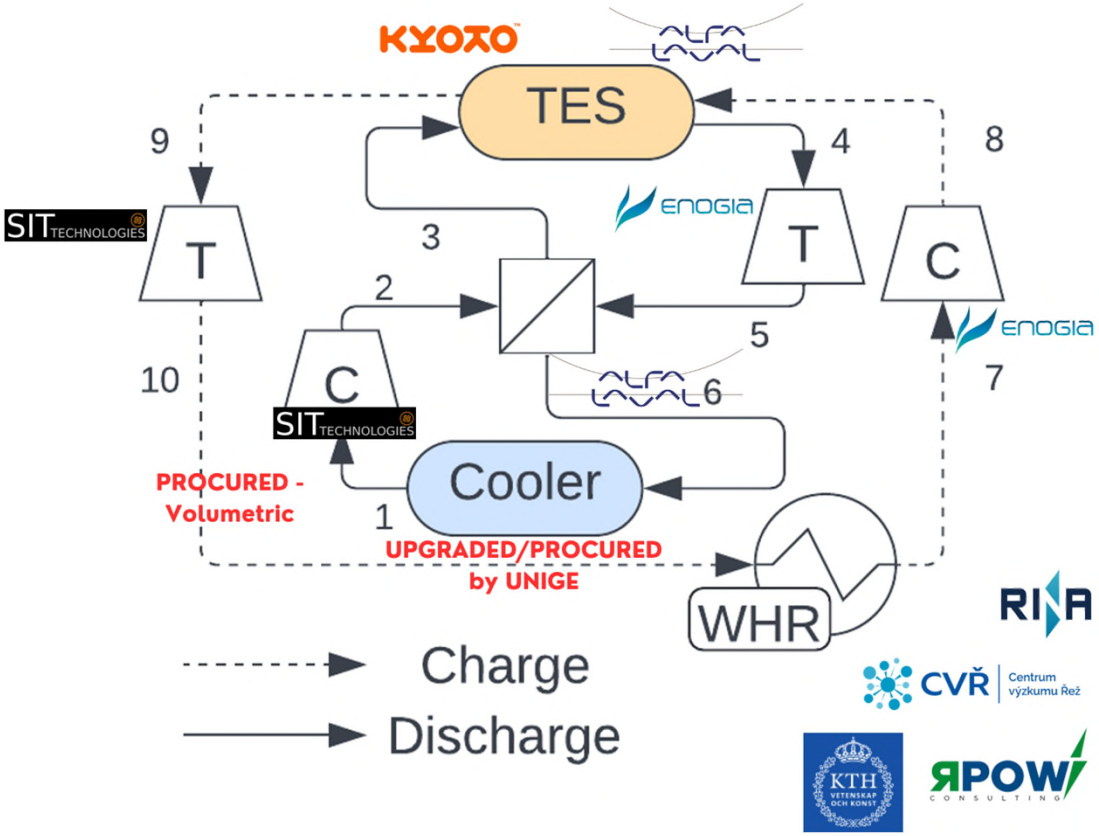
December 2023 – November 2027.
TRL5 campaign expected Q2-Q4 2027.

16 partners Coordinated by UNIGE
Approx. 5 M€ total budget (4.7M€ EU funding)

SCO2OP-TES

SCO2OP-TES

Horizon EU Project GA # 101136000



	Point	Pressure [bar]	Temperature [°C]	Mass flow rate [kg/s]
Discharge	1	82.98	33	0.72
	2	172	54.69	
	3	171.99	168.82	
	4	170.27	340	
	5	83	280.98	
	6	82.99	77.91	
Charge	7	85.35	240	0.717
	8	200	360	
	9	198	188.83	
	10	86.21	135.32	

Component	Power [kW]
CC Compressor (η=73.3%)	85.5
CC turbine (η=40%)	15.59
DC Compressor (η=60%)	15.45
DC turbine (η=68.2%)	36.92
Hot TES Primary HEX	156.84
Cooler	135.14
WHR	87.74
Recuperator	176.42
RTE	30.6 %

COMHPTES
Project Overview

Co-funded by the European Union

Swedish Energy Agency

Scottish Enterprise

CDTI

Main Objective:

To develop and demonstrate a cost-effective modular solution for decarbonized industrial heating(up to 325°C) and cooling (at 5°C)

- CO2 compact compressor-expander and advanced heat exchangers
- Including cold and hot TES systems.
- 200kWt Demo - scalable to +1.5 MWt

Time-plan and budget :

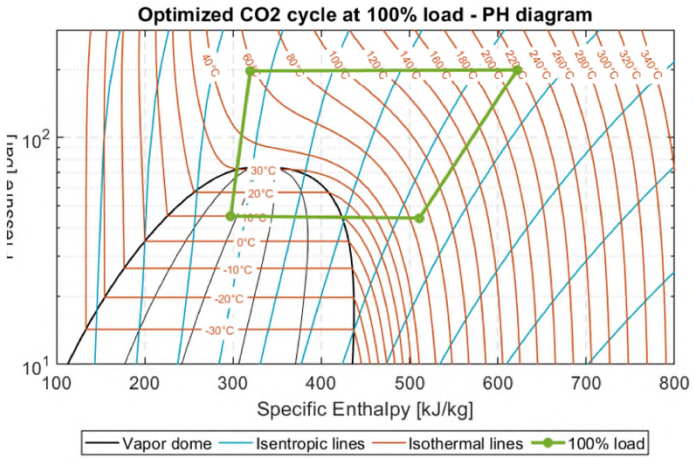
- November 2024 – November 2027.
- TRL5 campaign expected Q1-Q4 2027
- 5 partners coordinated by KTH
- Approx. 3 M€ total budget

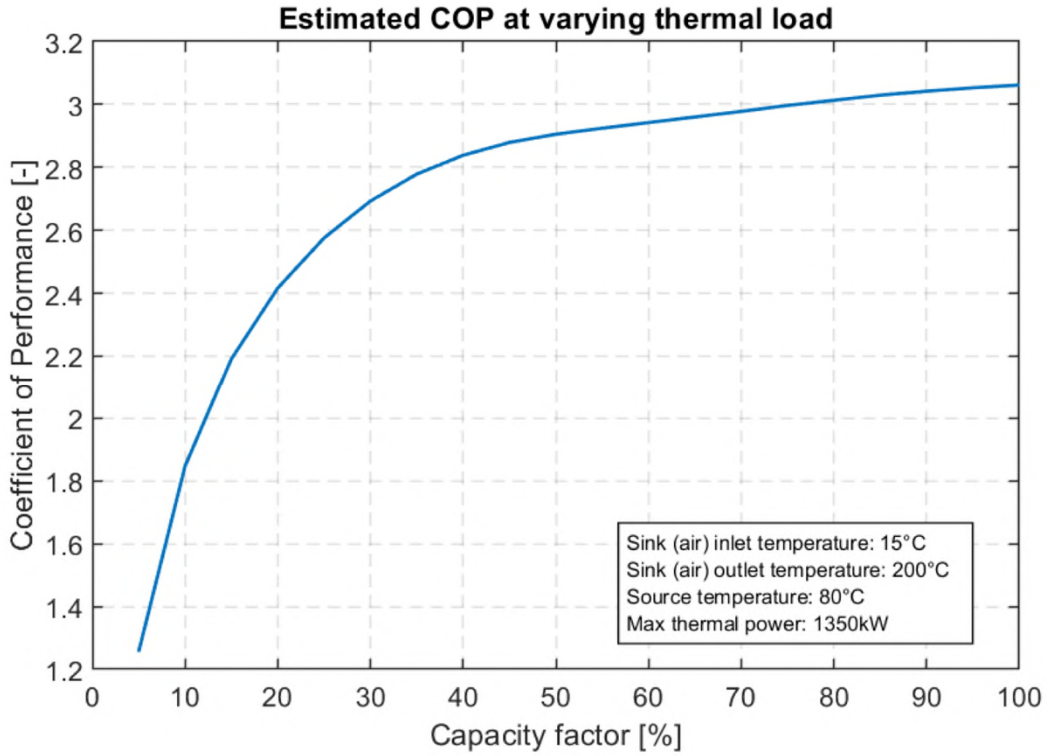
POWER INPUT:	0.5MW$_e$
MAX. POWER OUTPUT:	1.5MW$_{th}$
TEMPERATURE RANGE:	-100°C to +400°C
ISENTROPIC EFFICIENCY:	Up to 90%

COMHPTES
Project Overview

Co-funded by the European Union
Swedish Energy Agency
Scottish Enterprise
cet Partnership
CDTI

- **Estimated COP of 3.1 at peak load**
- High COP of 3.0, 2.9 and 2.6 at 75, 50 and 25% load respectively





SHARP-sCO2

Project Overview

Horizon EU Project GA # 101083899

Objective:

Enable a new generation of highly efficient and flexible hybrid PV-CSP plants

New components to TRL5 (Pilot):

- Air receiver + MV Air Electric Heaters
- Packed bed thermal storage using waste media
- Compact/modular Air-to-sCO2 Heat exchangers

Time-plan and budget :

October 2022 – October 2025.
TRL5 campaign Q2-Q4 2025.

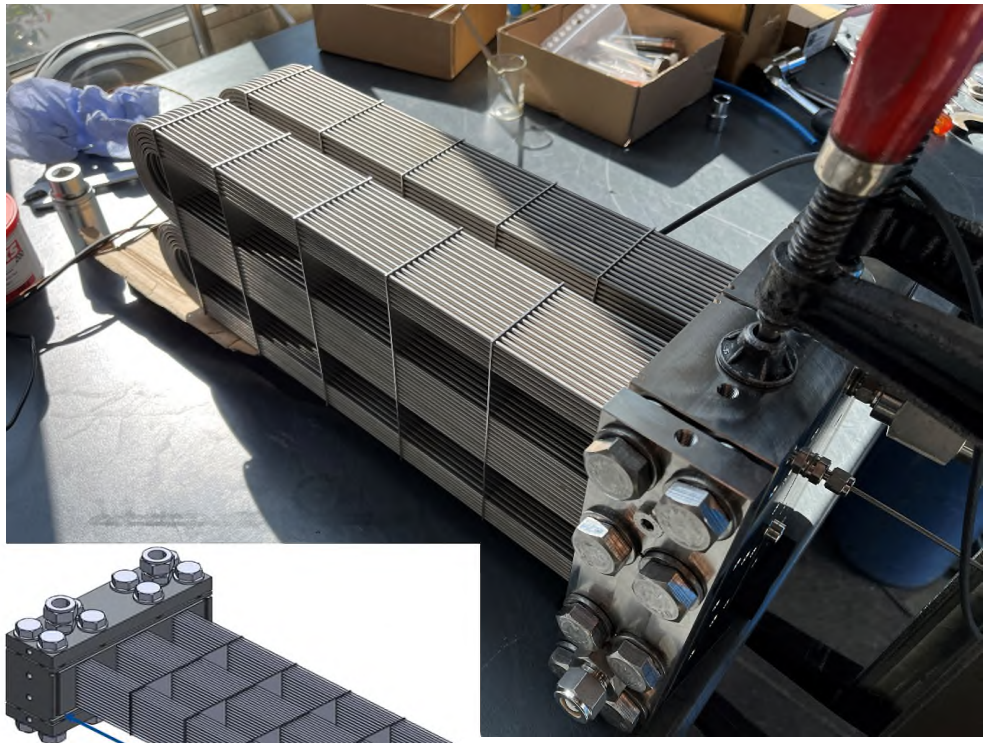
10 partners Coordinated by KTH
Approx. 3 M€ total funding (2.3M€ EU + 0.7 UKRI)

SHARP-sCO2

Air-to-sCO_2 Heat Exchanger

Horizon EU Project GA # 101083899

Target objective	Value	Achieved
Thermal duty of the prototype	50 kW (25 kW)	☑ 50 kW (prototype of two modules)
Air temperature at tests	up to 700 °C	(☑) (180 °C, cooling case)
sCO_2 temperature at tests	up to 650 °C	(☑) (≈ 300 °C, cooling case)
HEX effectiveness	> 85 %	☑ (93 %)
Pressure drop	< 2 %	☑



SOLARsCO2OL

Project Overview

H2020 Project GA No.952953

Objectives:

1. **2 MW scale sCO2 cycle DEMO (FOAK in EU, operating from molten salts)**
2. **Demo of MW molten salt electric heaters**
3. **Techno-economics of Hybrid PV-CSP sCO2**

Time-plan and budget :

October 2020 – 2026*

***Commissioning expected by summer 2026.**

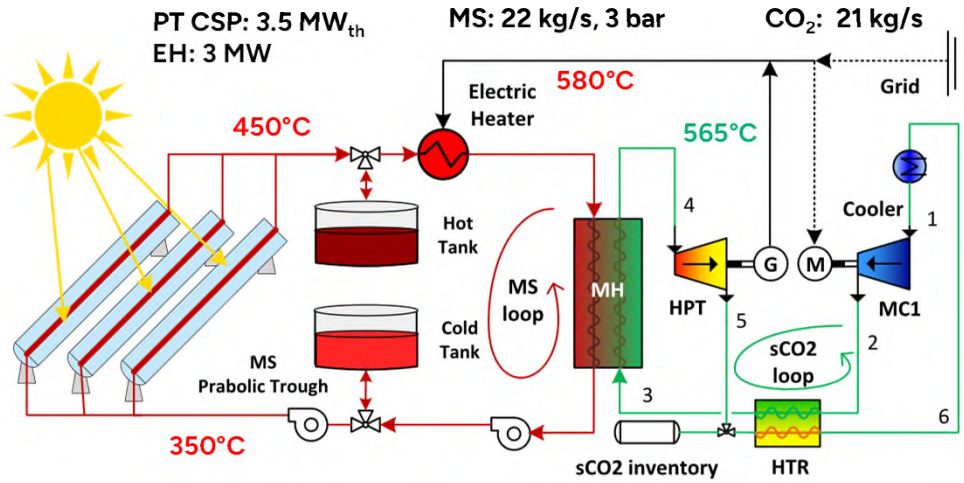
Civil works under completion – installation started

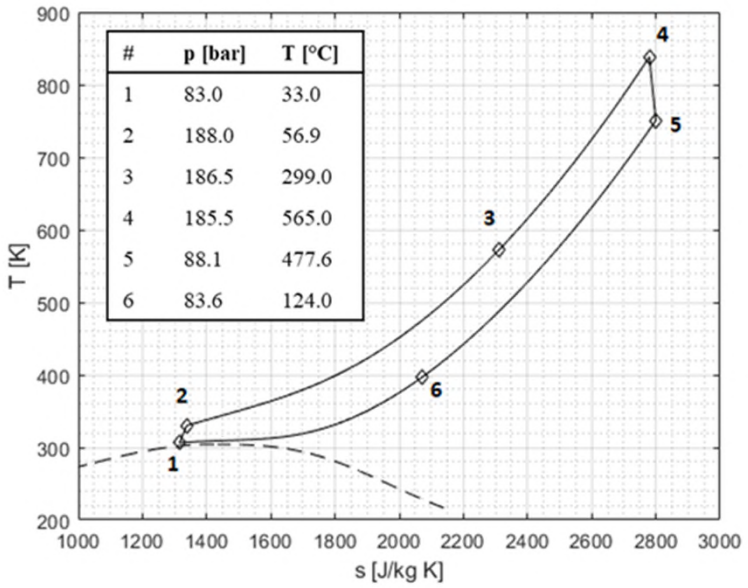
17 partners Coordinated by RINA Consulting
~20 M€ budget (10M€ EU funding)

SOLARsCO2OL

Demo at EMSP in Portugal

H2020 Project GA No.952953





#	p [bar]	T [°C]
1	83.0	33.0
2	188.0	56.9
3	186.5	299.0
4	185.5	565.0
5	88.1	477.6
6	83.6	124.0

Cycle Efficiency	22.1%
Total Efficiency	20.3%
Recuperator Effectiveness	80%
Turbine Efficiency	83%
Compressor Efficiency	67%
Mechanical Efficiency	96%
Electrical Efficiency	96%

Heater – Q	6.8 MW_{th}
Cooler – Q	5.3 MW_{th}
Recuperator – Q	8.7 MW_{th}
Turbine – P	1.96 MW_{th}
Compressor – P	0.47 Mw_e
Net Power	1.38 MW_e

THANK YOU

Department of Energy Technology

Division of Heat and Power Technology

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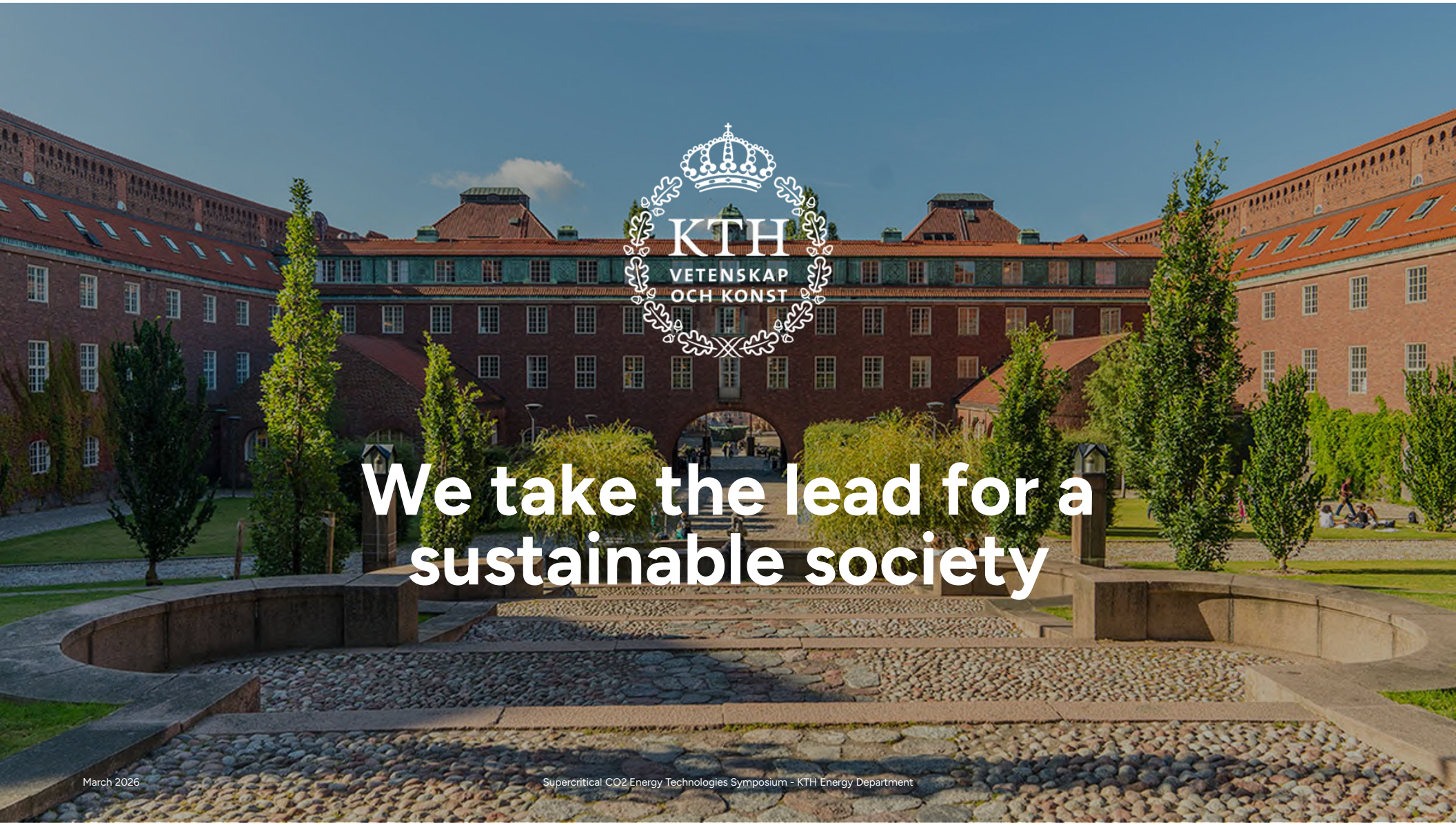

We take the lead for a sustainable society