



# Competence Center for Gas Exchange



”Charging for the future”

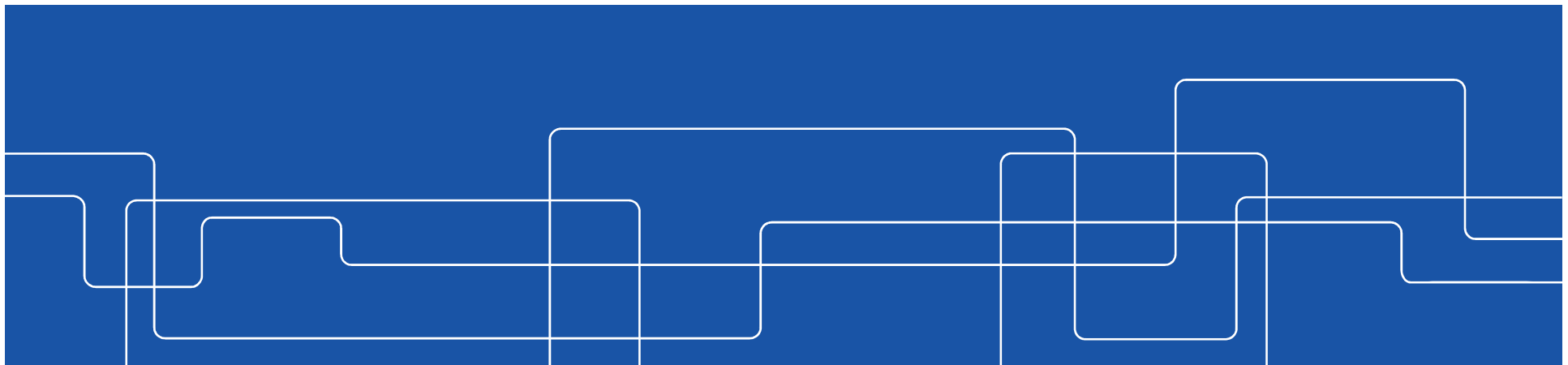




KTH ROYAL INSTITUTE  
OF TECHNOLOGY

# CCGEx Research Days Program

11 and 12th of October  
2018 Stockholm KTH



**VOLVO**



**BorgWarner**



# Agenda – 12th October

## Room Gladan, Brinellvägen 83

08:30 **Kick-off the new program period by CCGEx Director-** Anders Christiansen Erlandsson

09:00-10:15 **New Research Areas, Projects, and Students**

- i-COLD Mihai Mihaescu:

- Compressor Response to upstream/downstream installation effects and perturbations – Emelie Trigell, PhD Student
- Aerodynamically generated noise of centrifugal compressors – Experiments – Post Doc (NN)
- Non-linear system identification techniques for acoustic characterization of turbochargers under high level of pulsating flow excitation - *Marie Curie student* Niloofar Sayyad Khodashenas (*4:th year*) – *Associated project*

- i-HOT Mihai Mihaescu:

- Turbocharger turbine efficiency in steady and pulsating inlet flows – experiments – Yushi Murai, PhD Student
- Turbine performance optimization with focus on maximizing exergy transfer – Roberto Mosca, PhD Student

10:15-10:45 **COFFEE**

10:45-12:00

- i-SYS Anders Christiansen Erlandsson:

- Exergy losses in high efficiency charging – Beichuan Hong, PhD Student
- Engine charging and EAT interaction during transients – Varun Venkataraman, PhD Student
- Waste Heat Recovery in Pulsating Flows-New techniques – Jianhua Zhou, Post-doc

12:00-13:00 **LUNCH**

13:00-14:00 **IAB meets CCGEx leadership team**

- Summary of impressions

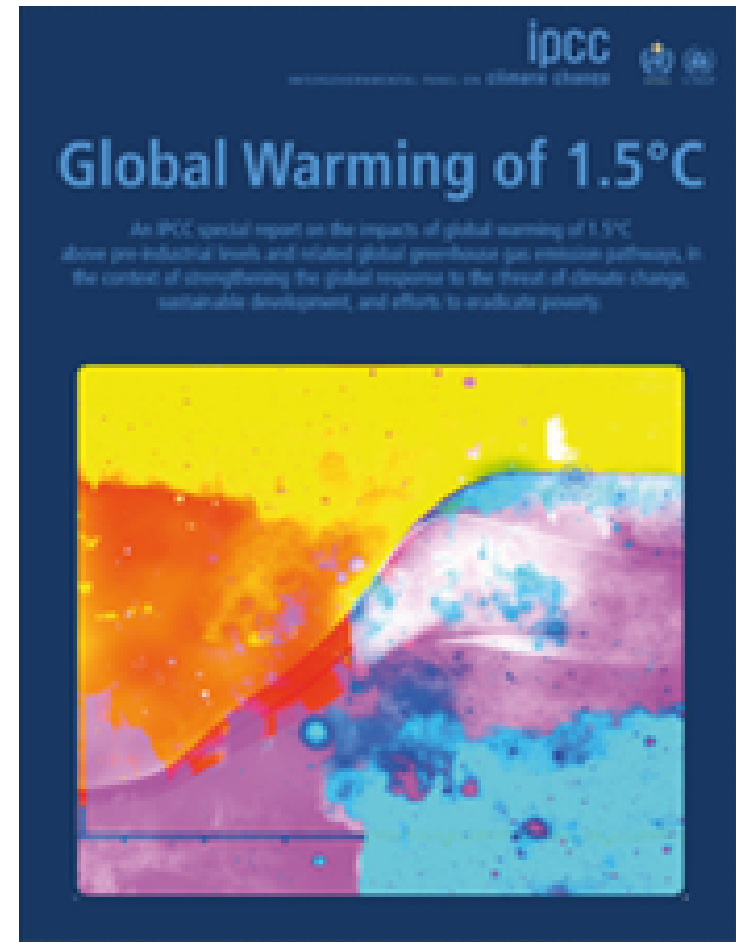
14:00-15:00 **Optional Lab Tour**





## Act now!

The report finds that limiting global warming to 1.5°C would require “rapid and far-reaching” transitions in land, energy, industry, buildings, transport, and cities. Global net human-caused emissions of carbon dioxide (CO<sub>2</sub>) would need to fall by about 45 percent from 2010 levels by 2030, reaching ‘net zero’ around 2050. This means that any remaining emissions would need to be balanced by removing CO<sub>2</sub> from the air.



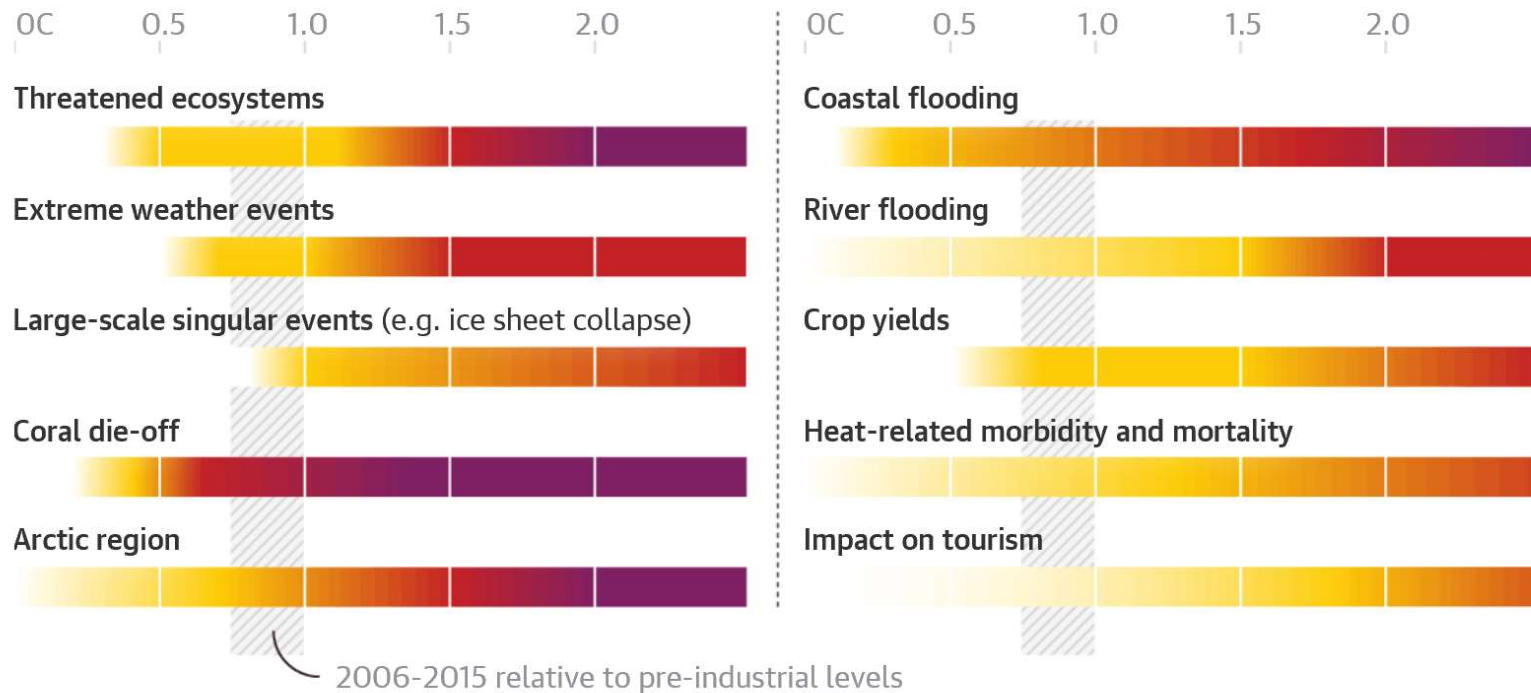


# Be aware of consequences

## Key to impacts and risks



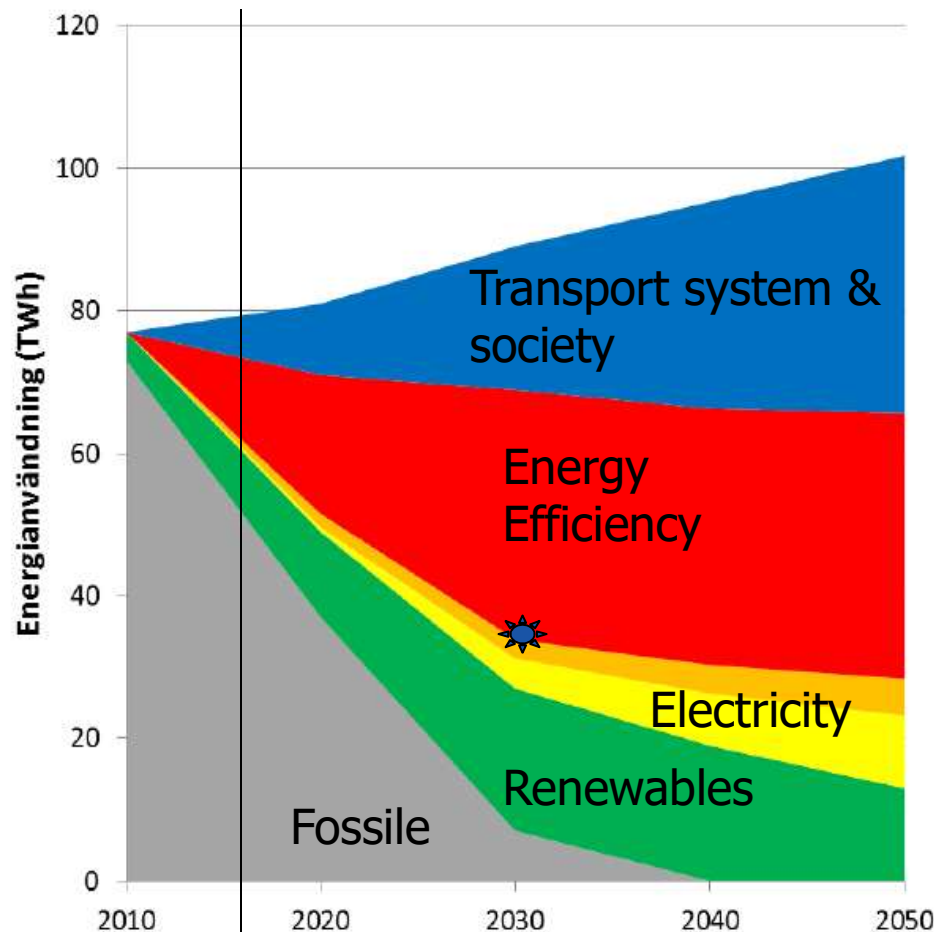
## Global mean surface temperature change relative to pre-industrial levels, C



Guardian graphic. Source: IPCC Special Report on Global Warming of 1.5C



# Swedish reduction SCENARIO! Towards fossile free transport in SWEDEN



By 2030:

- Society & transports
- 50% higher efficiency
- 60% biofuels or renewables
- Squirt of fossile and electricity

Källa: SOU 2013:84, Fossilfrihet på väg ("FFF-utredningen")

# By 2030: 50% less energy consumption – How the .....?

Less energy required for propulsion

- Drag & rolling resistance, weight, regeneration

Efficient energy production

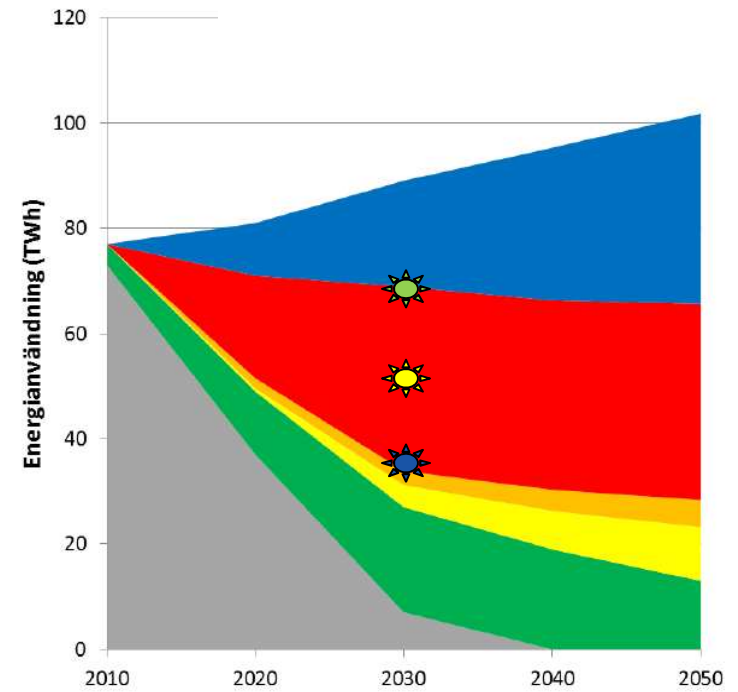
- Highly efficient power train

Split 50% energy reduction into

- 25% less for propulsion (yellow star)
- 33% less for production (blue star)

Propulsion efficiency 40% to 60% !!!

Add renewables & electricity







GREENPEACE

MEET LISA. AN 8-YEAR-OLD EMISSIONS FILTER!

## Four major cities move to ban vehicles by 2025

By Matt McGrath  
Environment correspondent

🕒 2 December 2016 | Science & Environment



Air quality in Paris has forced political leaders to take a hard stance on the u

## Petrol and diesel ban: How will it work?

🕒 26 July 2017 | UK



All sales of new petrol and diesel cars will cease in the UK by 2040, under plans to tackle air pollution.

But with electric cars currently accounting for less than 1% of new sales, the switch will mean seismic changes, and gives rise to a host of pressing questions.

### Why are petrol and diesel cars being banned?

Poor air quality is the "biggest environmental risk to public health in the UK" - thought to be **linked to about 40,000 premature deaths a year** - the government says. While air pollution has been mostly falling, in many cities nitrogen oxides - which form part of the discharge from car exhausts - regularly breach safe levels.

Diesel vehicles produce the overwhelming majority of nitrogen oxide gases coming from roadside sources.

The government was ordered by the courts to produce **a new plan** to tackle illegal levels of harmful pollutant nitrogen dioxide, a form of the nitrogen oxide pollutants emitted by vehicles.



# CCGEx Kick-off period 2018-2021

How to achieve sustainable mobility or sustainable propulsion for transport?

Global warming – STOP – Fossil free 2050

Local emissions - ZERO

Sustainable business – Better than competition?

Renewable fuels sources – BIO, SUN, WIND

Well to wheel efficiency

Cradel to grave CO2

Zero emissions

Knowledge & understanding to engineer great products

# Research focus 2018-2021

	Urban	Highway
Light Duty	<p><b>Prioritized properties:</b></p> <ul style="list-style-type: none"> <li>• "Emissions free"</li> <li>• Silent</li> </ul> <p><b>Prioritized Technologies:</b></p> <ul style="list-style-type: none"> <li>• Hybrid/ elektrified engine</li> <li>• Electrification</li> <li>• PZEV ICE</li> </ul>	<p><b>Prioritized properties:</b></p> <ul style="list-style-type: none"> <li>• Energy efficiency</li> <li>• CO2/GHG</li> </ul> <p><b>Prioritized Technologies:</b></p> <ul style="list-style-type: none"> <li>• ICE</li> <li>• Hybrid/ elektrified engine</li> <li>• Fossile free fuels</li> </ul>
Heavy Duty	<p><b>Prioritized properties:</b></p> <ul style="list-style-type: none"> <li>• "Emissions free"</li> <li>• Silent</li> </ul> <p><b>Prioritized Technologies:</b></p> <ul style="list-style-type: none"> <li>• Hybrid</li> <li>• Plug-in hybrid</li> <li>• Electrified road - hybrid</li> </ul>	<p><b>Prioritized properties:</b></p> <ul style="list-style-type: none"> <li>• Energy efficiency</li> <li>• CO2/GHG/NOx/PM</li> </ul> <p><b>Prioritized Technologies:</b></p> <ul style="list-style-type: none"> <li>• ICE</li> <li>• Hybrid/ elektrified motor</li> <li>• Fossile free fuels</li> <li>• Electrified road - hybrid</li> </ul>



# CCGEx Targets & Goals 2018-2021



- ❑ Higher powertrain efficiency through:
  - Increased gas exchange and turbocharging efficiency
  - Higher charge pressure enabling efficient thermodynamic cycles (e.g. Miller)
  - Lower aerothermodynamic losses
  - Efficient and smarter EGR systems for optimized, diluted & cold combustion: smart EGR-turbocharger-Intercooling integration
  - Integrated waste heat recovery (WHR)
- ❑ Enhance hybridization potential for a better response & efficiency under transients
- ❑ Better methods for thermal handling and regulation of after-treatment systems
- ❑ Zero emissions during real use (RDE)
- ❑ Increased inlet pressure during transients for better response
- ❑ Enable transition to 100% renewable fuels in SI and CI engines



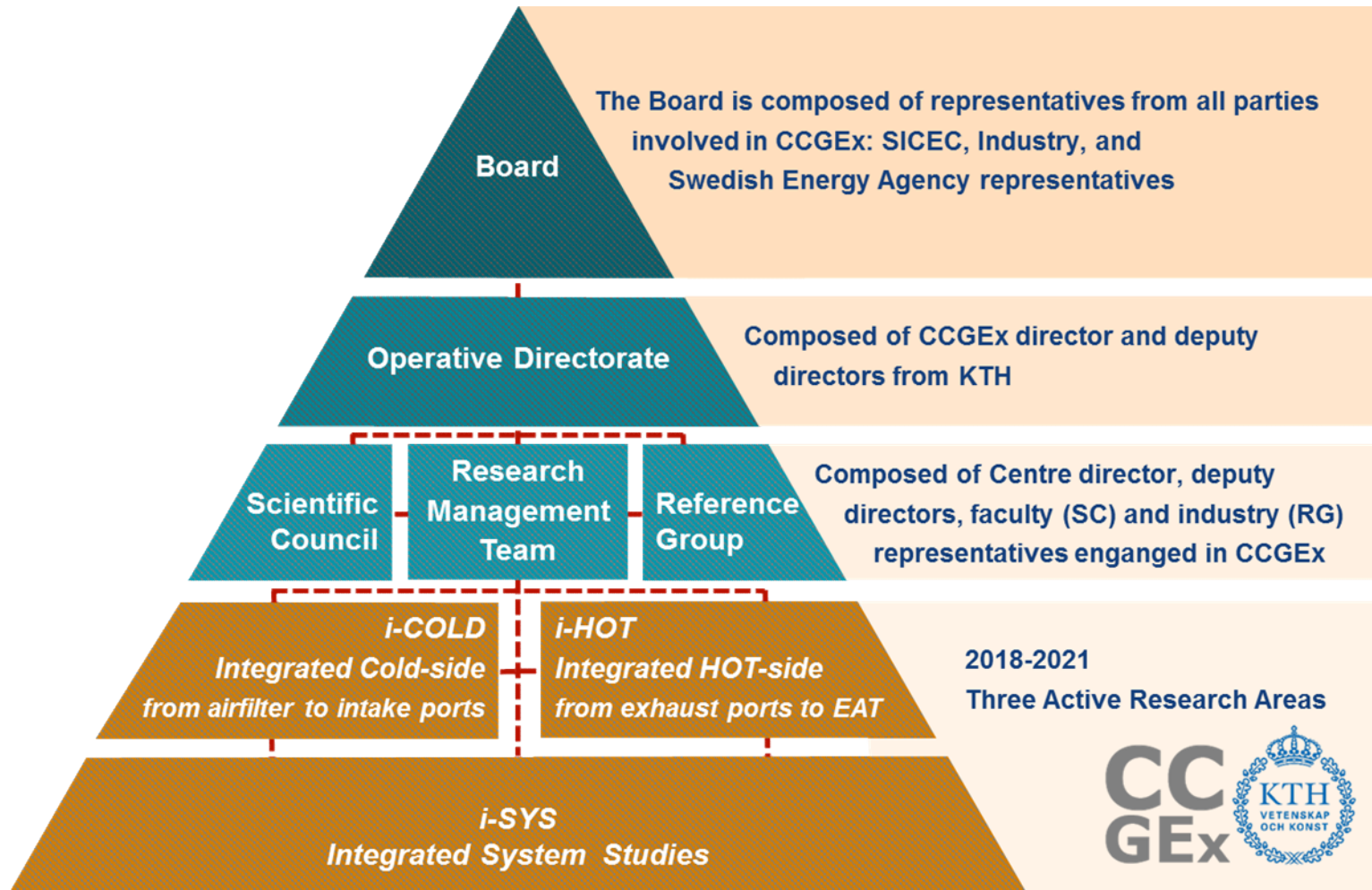
# Program budget 2018-2021

## CCGEX 2018-2021

		Budget				Total
		B2018	B2019	B2020	B2021	
<b>Cash</b>						
KTH	kkkr	1000	1000	1000	1000	4000
Energimyndigheten	kkkr	8550	8550	8550	8550	34200
Scania	kkkr	800	800	800	800	3200
Volvo Cars	kkkr	500	500	500	500	2000
Volvo GTT	kkkr	800	800	800	800	3200
Borg Warner	kkkr	800	800	800	800	3200
Wärtsilä	kkkr	250	250	250	250	1000
Other	kkkr	0	0	0	0	0
<b>Kontant Summa</b>		12700	12700	12700	12700	50800
<b>Inkind</b>						KTH in-kind
KTH	kkkr	9000	9000	9000	9000	36000
Energimyndigheten	kkkr	-	-	-	-	-
Scania	kkkr	900	900	900	900	
Volvo Cars	kkkr	1200	1200	1200	1200	
Volvo GTT	kkkr	900	900	900	900	
Borg Warner	kkkr	900	900	900	900	
Wärtsilä	kkkr	1500	1500	1500	1500	
Other	kkkr	0	0	0	0	Industry in-kind
<b>In-kind Summa</b>		5400	5400	5400	5400	21600
						(Grand total)
<b>Distribution</b>		<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	
KTH	kkkr	10000	10000	10000	10000	40000
Energimyndighet	kkkr	8550	8550	8550	8550	34200
Industri	kkkr	8550	8550	8550	8550	34200
						108400



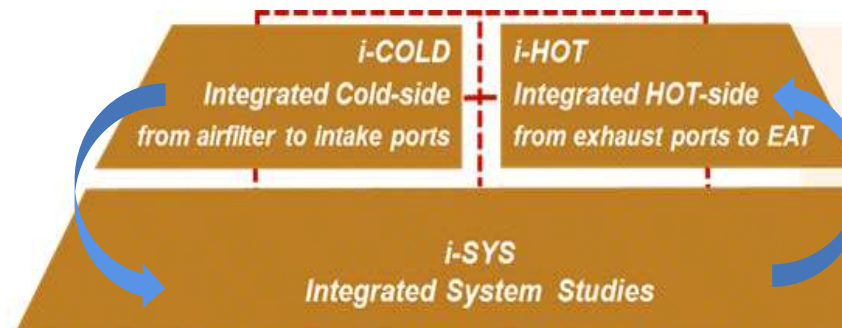
# CCGEx Organization 2018-





# Research area & project interactions

- Improved reduced order models
- Detailed data/knowledge
- Accurate predictions
- New models for acoustics etc...



- Boundary conditions –  $\rho, T, \text{massflow}(t)$
- Pulse shapes – pulsatile flow
- Installation effects
- Transients





## Partner value proposition

- Core technology area in focus – Gas exchange system
- Collaboration with state-of-art academic institution – KTH
- Partnership possibilities with Volvo Cars, VOLVO, Wärtsilä Borg Warner & SCANIA
- Access to senior researchers/professors with deep knowledge
- Generation and transfer of knowledge with the potential to significantly impact turbo charging performance
- Results from 19 relevant projects with theoretical, simulation and experimental content
- Access to unique laboratory and calculation facilities
- High gearing on deployed funding 15:1
- Detailed studies & unsteady/transient phenomena





# Competence Center for Gas Exchange



”Charging for the future”



**VOLVO**



**BorgWarner**

[www.ccgex.kth.se](http://www.ccgex.kth.se)