Stoichiometry **C**ontrolled **O**xidation (S.C.O.) technology for industrial **Ammonia** combustion

(Another green / clean energy solution)

Contents

- Introduction Duiker Combustion Engineers.
- SCO: combustion of NH_3 with minimised levels of NOx.
- Examples for NH_3 combustion in Sulphur Recovery Units.
- Features SCO technology.
- SCO concept for “Green” ammonia applications.
- Example of SCO technology in coal fired power stations.
- Questions?

Thousands of process solutions. Duiker Combustion Engineers You can rely on our experience.

Duiker CE founded in **1972**

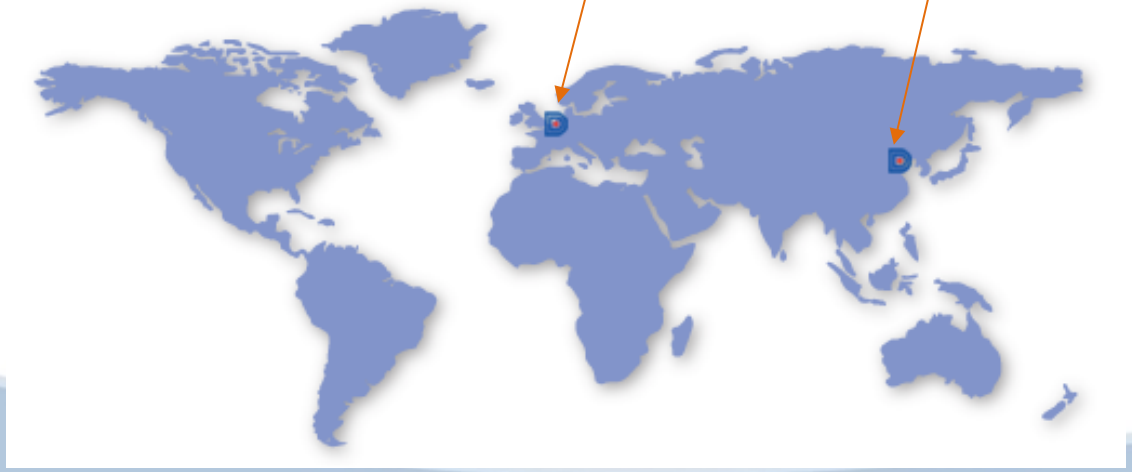
Customers:
EPC contractors &
End users, such as:
Major oil & **(petro) chemical companies**

> 2000 combustion solutions supplied worldwide

Duiker Combustion Engineers

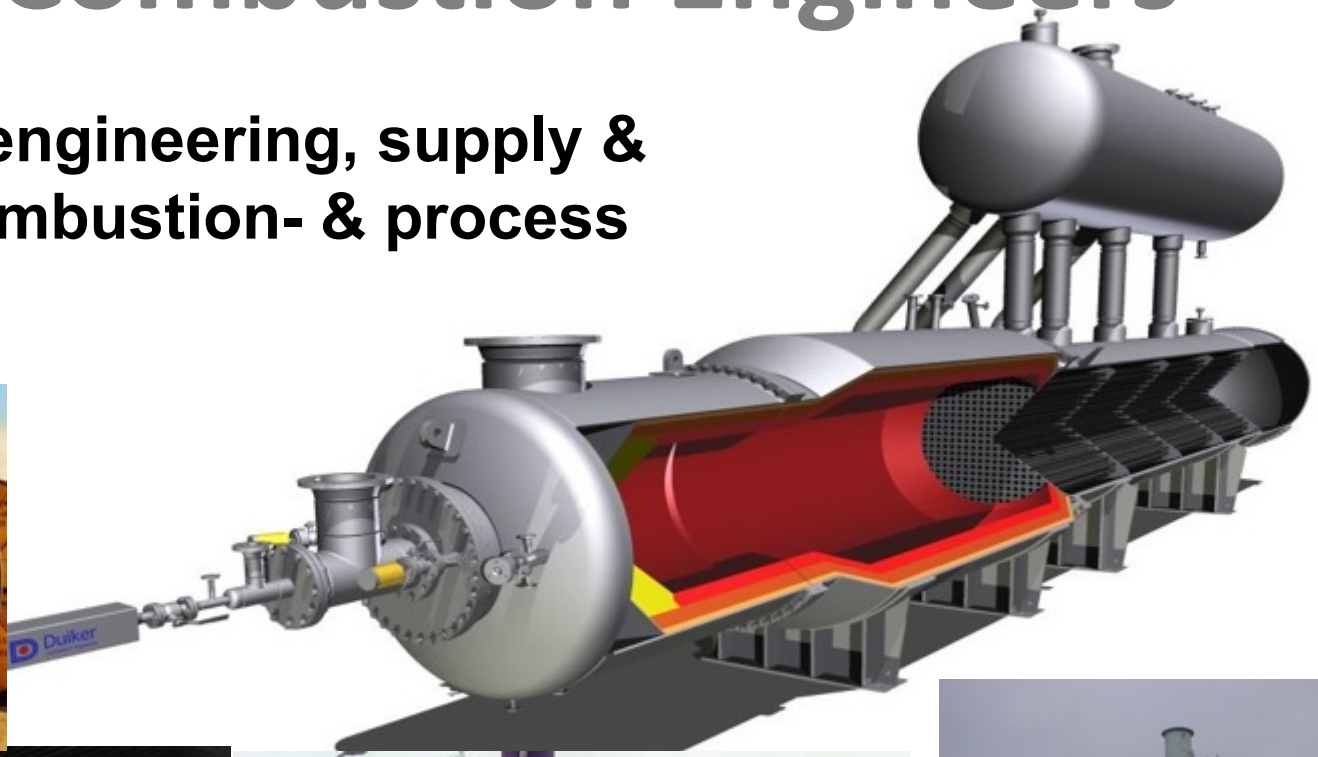
Main office in Wateringen, The Netherlands

Duiker China located in Beijing, PRC



Duiker Combustion Engineers

Development, engineering, supply & servicing of combustion- & process equipment



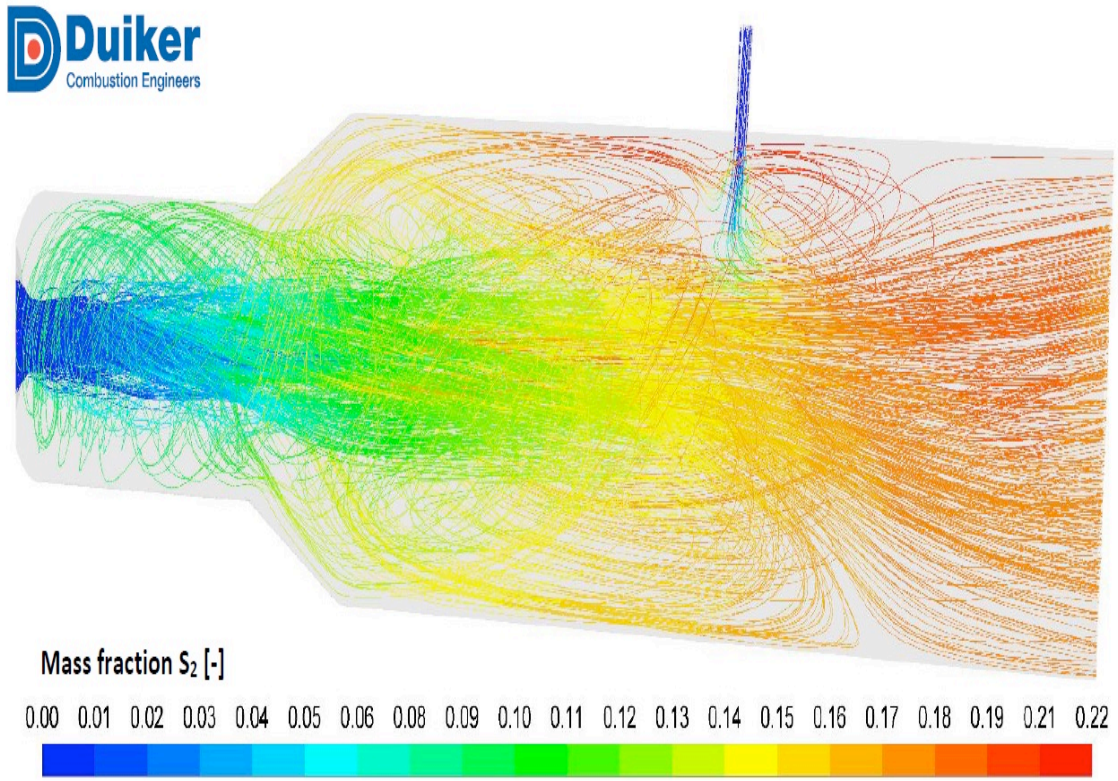
Duiker Combustion Engineers

Market leader in combustion equipment for Sulphur Recovery Units (SRU)

Approx. 75 employees

Duiker Combustion Engineers

In-House capabilities for Computational Fluid Dynamics (CFD)



Own test furnace of 3MW

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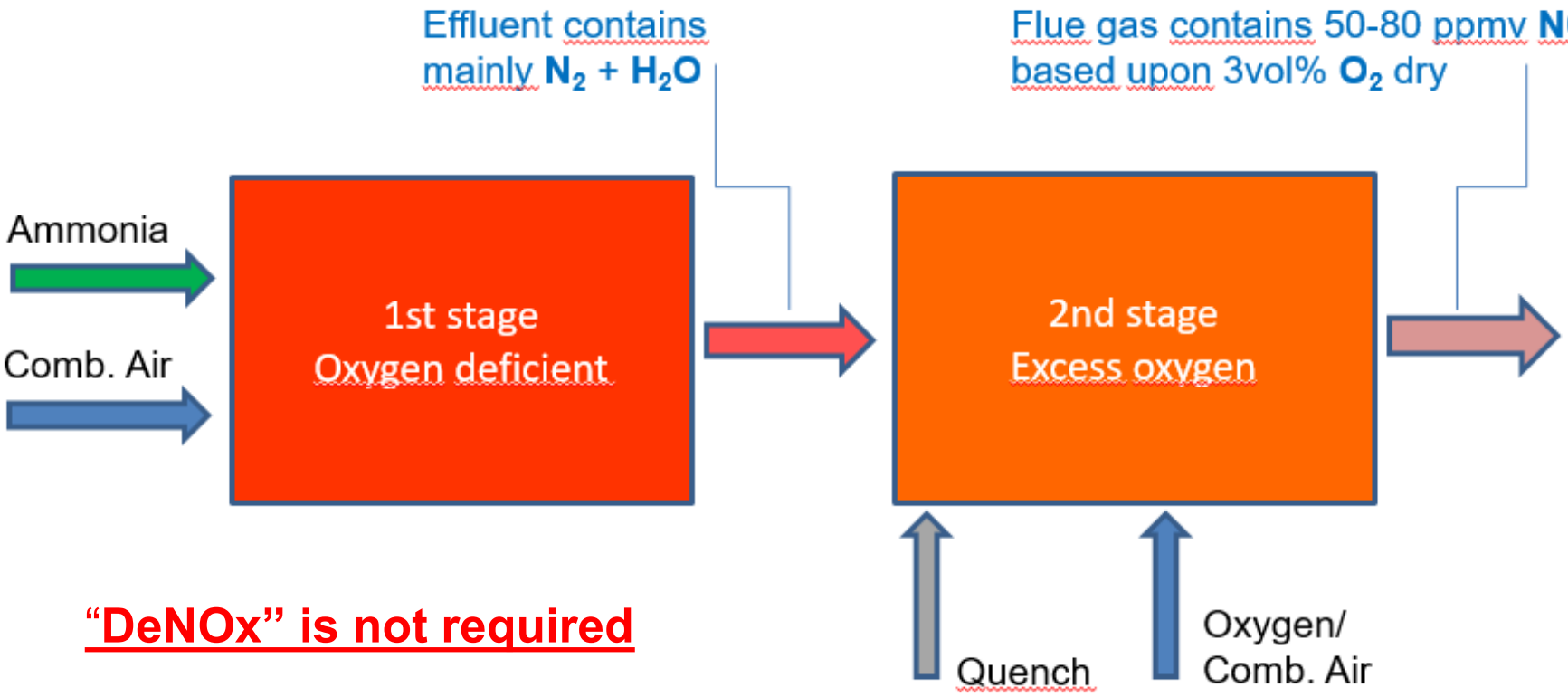
Combustion of **Ammonia** with minimised levels of NOx

Stoichiometry Controlled Oxidation (S.C.O.)



"DeNOx" is not required

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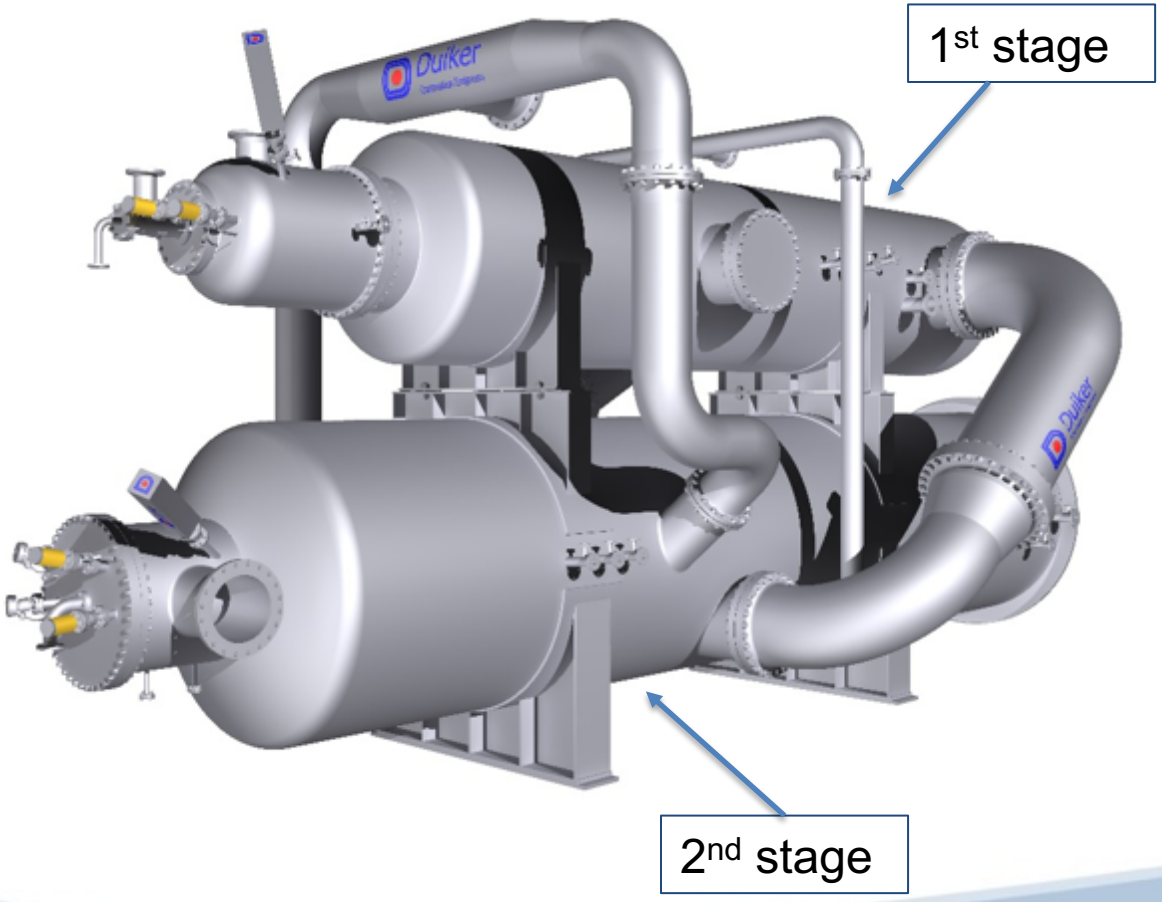
First commercial ammonia SCO unit applied in a SRU (2009) [example 1]



First commercial ammonia SCO unit applied in a SRU (2009) [example 1]

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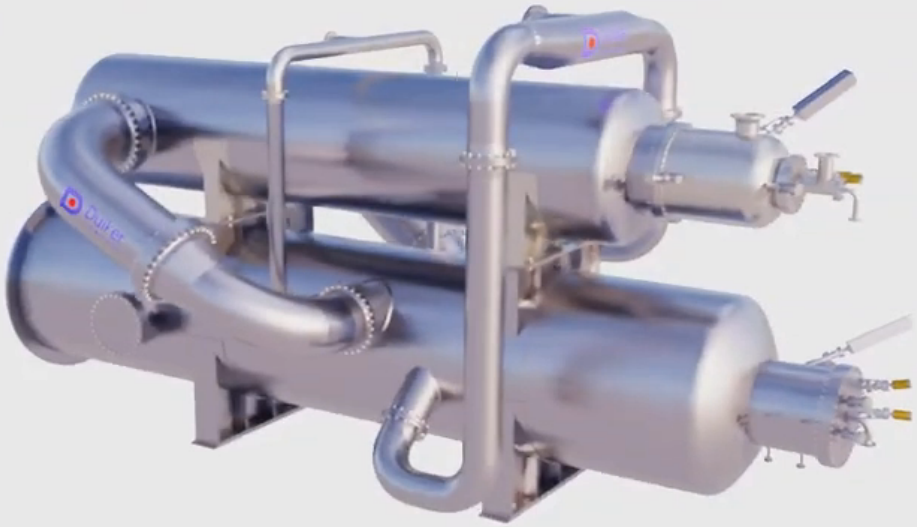
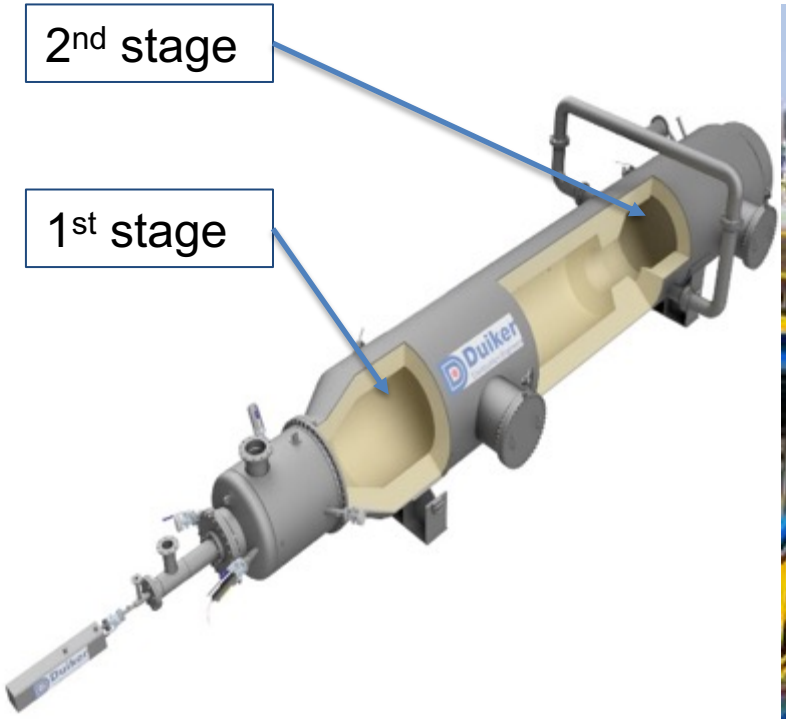
Combustion Engineers



STOICHIOMETRIC CONTROLLED OXIDATION

First commercial ammonia SCO unit applied in a SRU (2009) [example 1]

Commercial ammonia SCO unit applied in a SRU (2018) [example 2]



Measured NO_x: 50-80 ppm [v] (3% O_2 dry), without "DeNOx"

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Duiker 's Stoichiometry-Controlled Oxidation (SCO) Process

Features:

- ✓ Controlled conversion of NH_3 into useable heat & limiting formation of NO_x (without a DeNOx).
- ✓ Robust process, easy to operate & fast response to upset conditions.
- ✓ Proven, scalable & commercially available technology.
- ✓ SCO technology has been patented.

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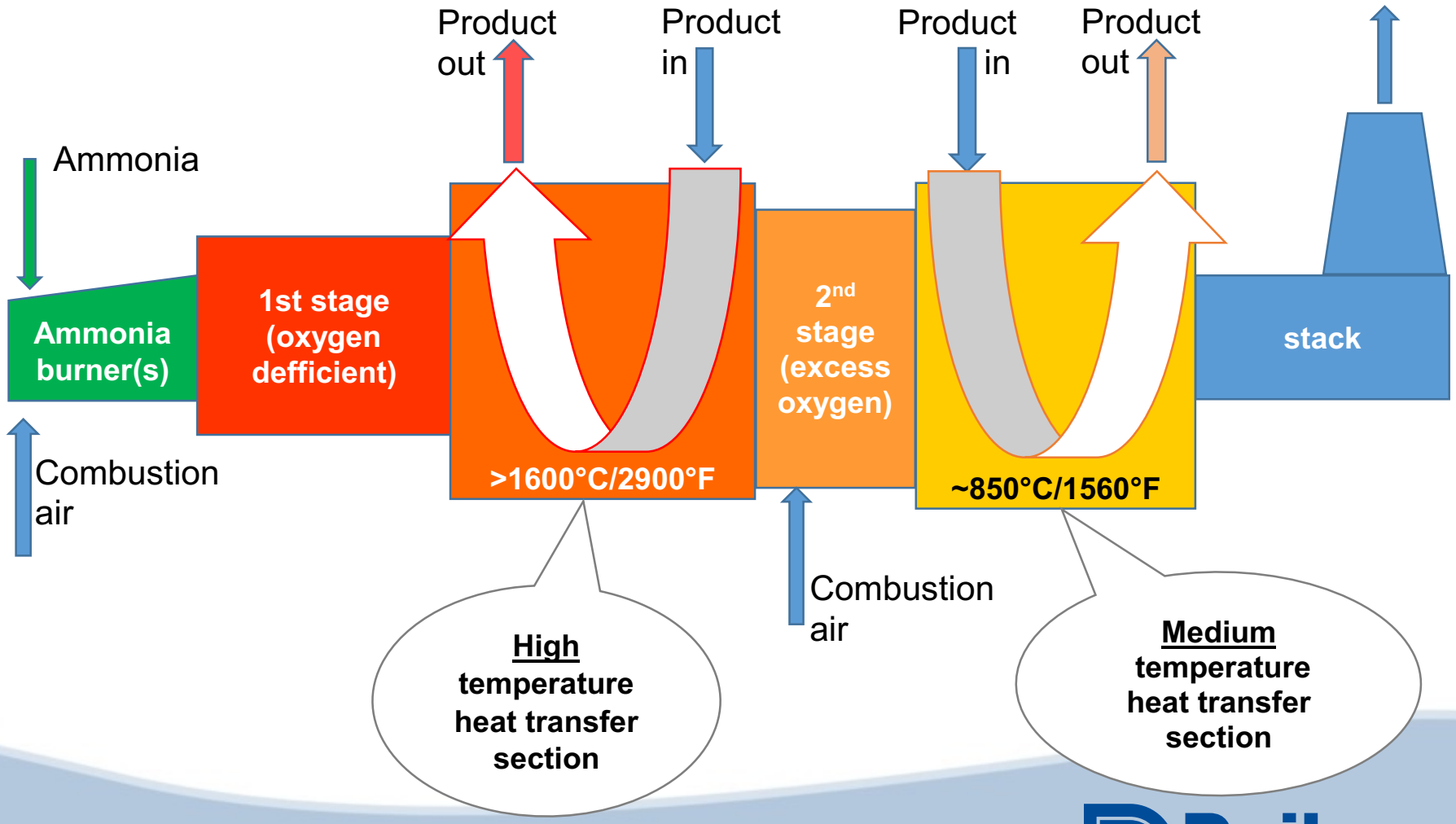
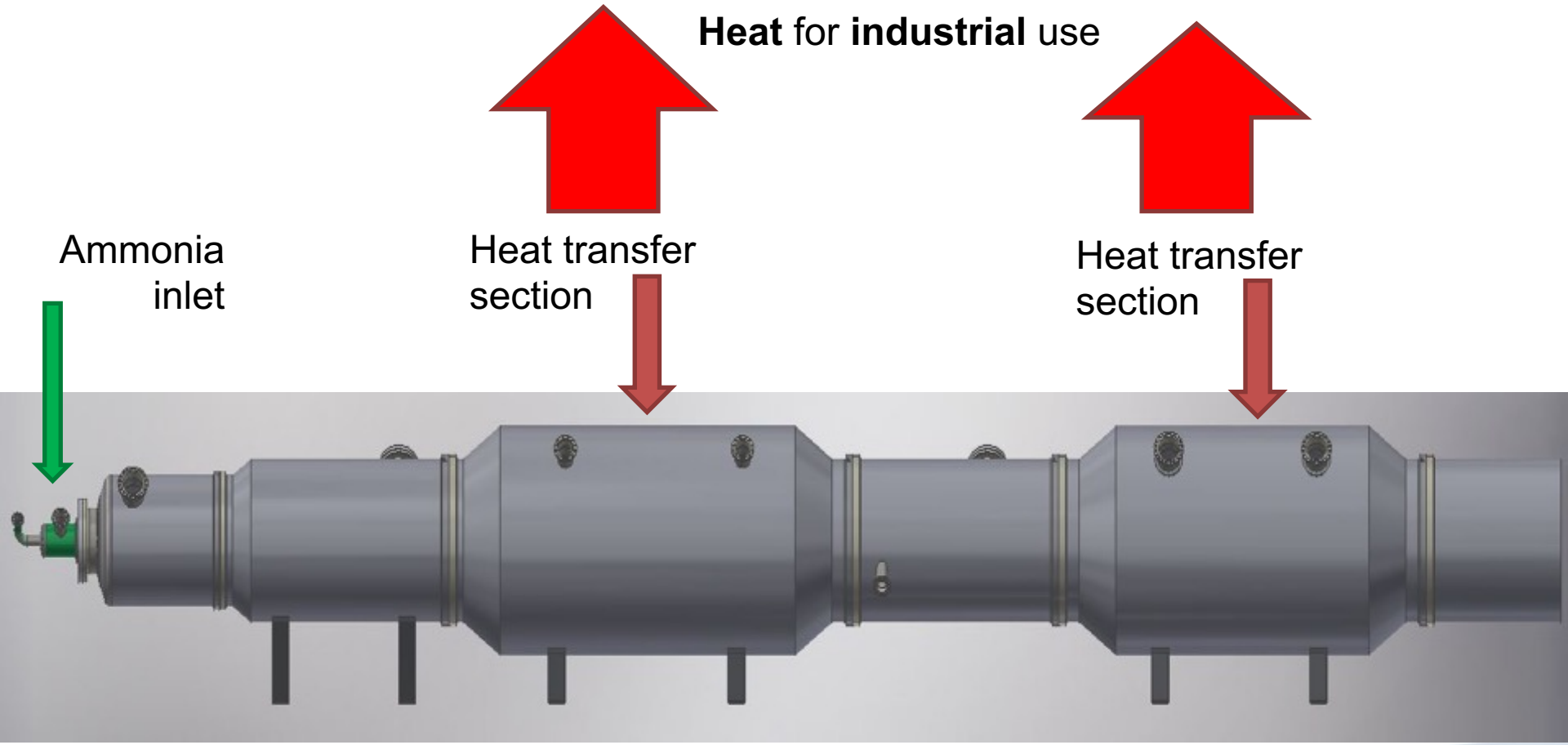
SCO conceptual design for conversion NH_3 into heat

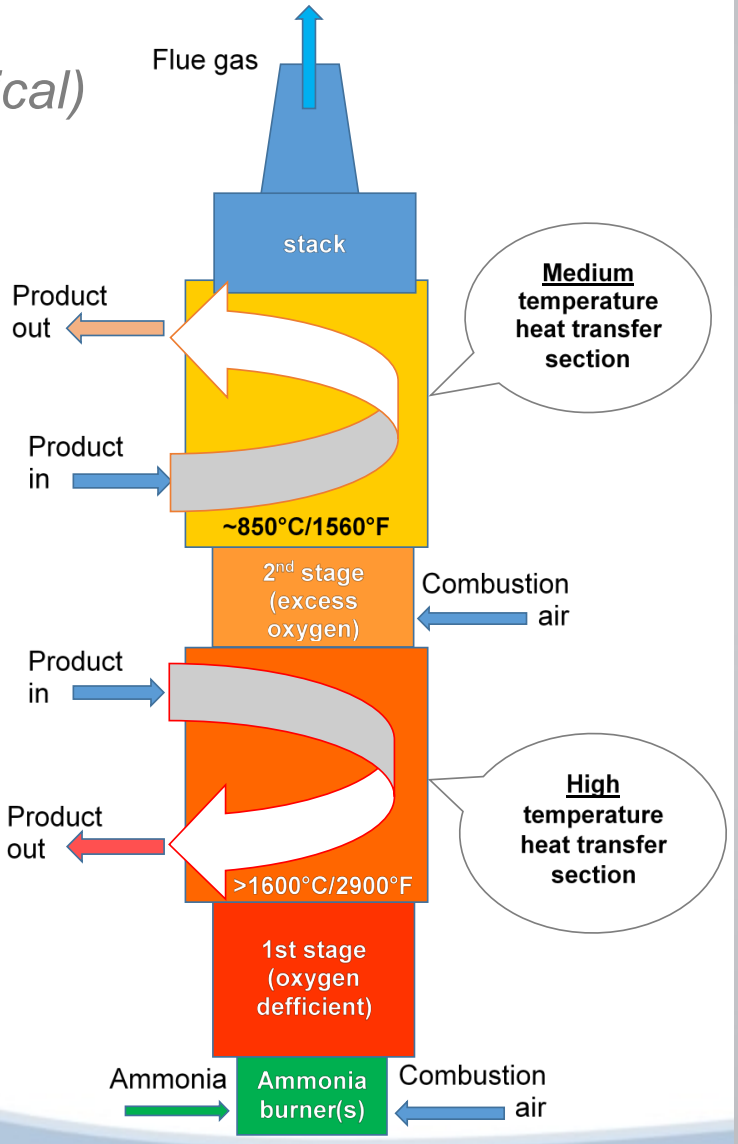


SCO imaginable design for conversion NH_3 into heat

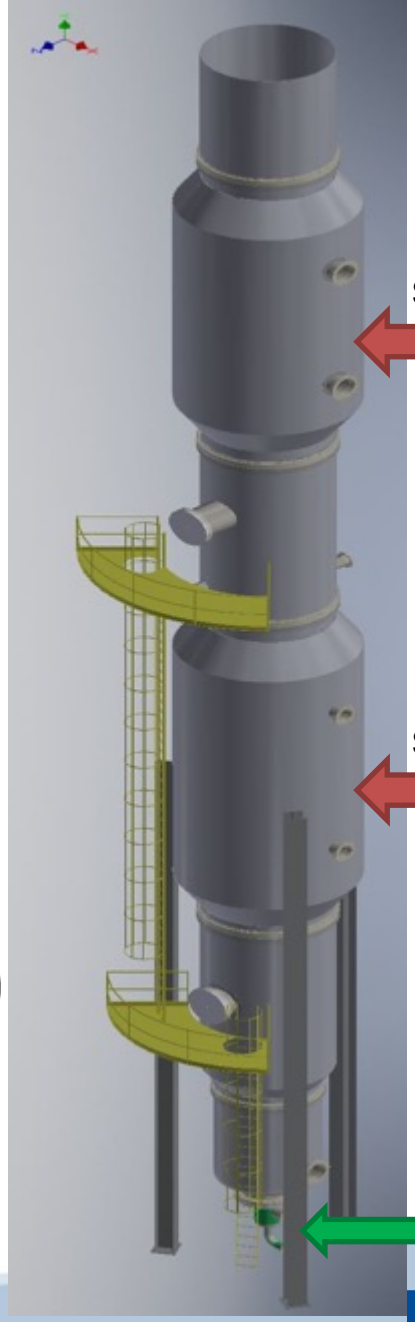


SCO technology :

Conceptual design (vertical)



Imaginable design (vertical)



Heattransfer section

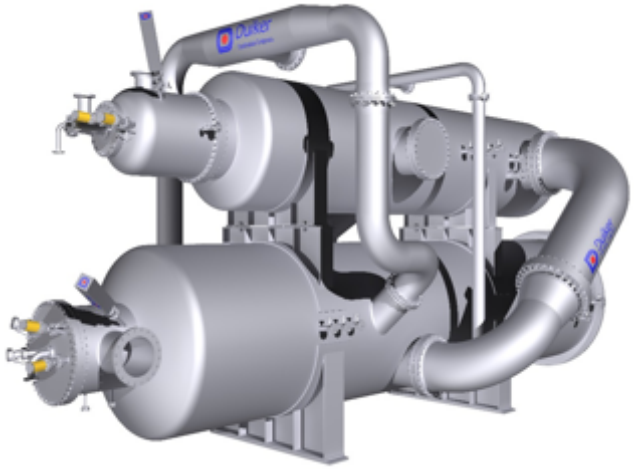
Heat for industrial use

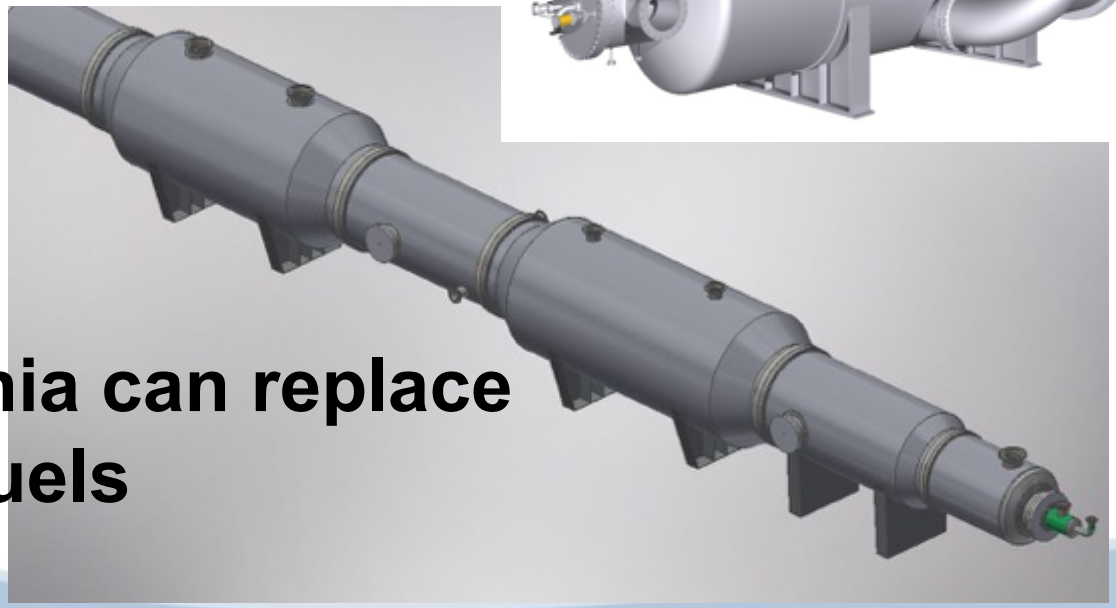
Heattransfer section

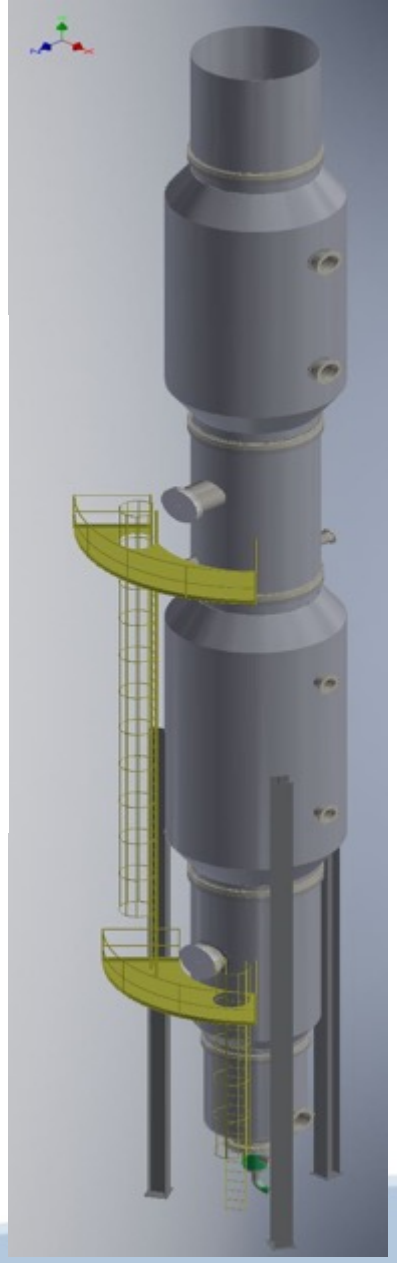
Ammonia inlet

SCO technology: a solution for high temperature “electrification”

- ✓ Fired heaters / ovens
- ✓ Industrial gas fired furnaces
- ✓ Naphta crackers
- ✓ Gas fired turbines
- ✓ Steamboilers
- ✓ (Coal fired) powerplant







Ammonia can replace fossil fuels

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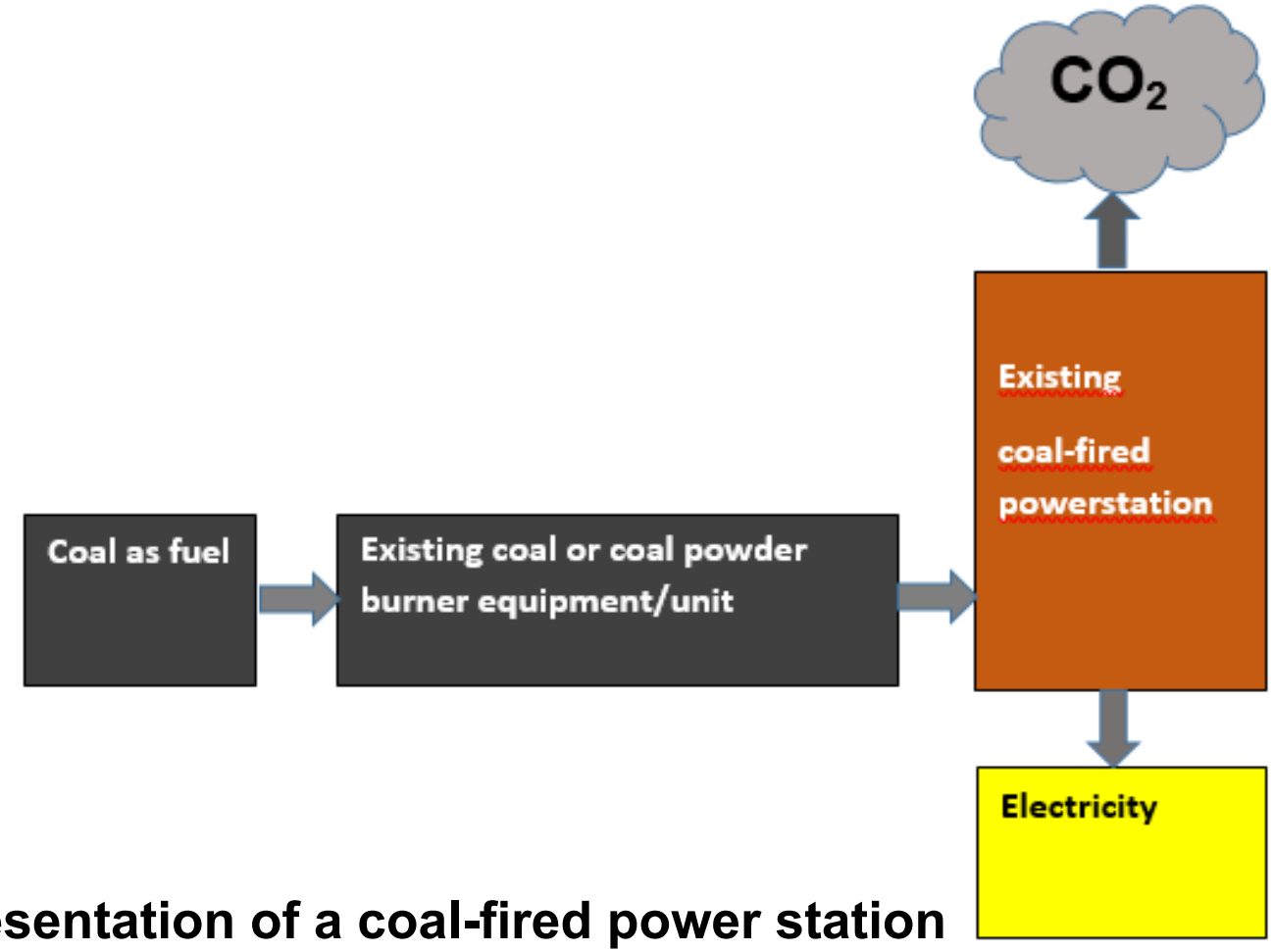
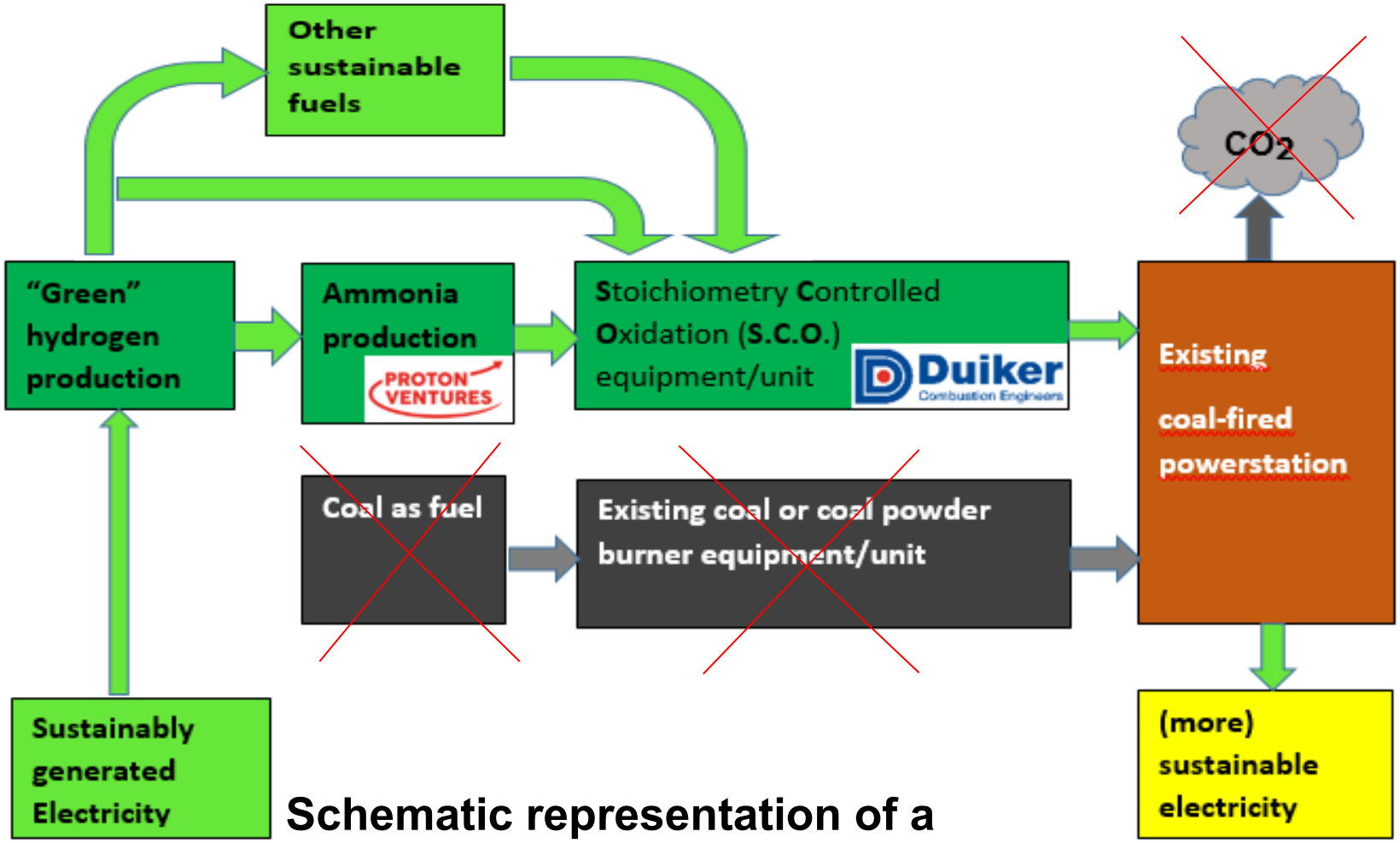
SCO technology ”example” for a coal fired power station



Schematic representation of a coal-fired power station

SCO technology converts NH_3 into high-temperature heat for a **sustainable multi-fuel** coal fired power station



Schematic representation of a sustainable multi-fuel coal-fired power station

Duiker's **S.C.O. Technology:**

Any questions?

- ✓ Proven, scalable & commercial available solution for NH_3 conversion to high temperature heat (>1600°C / 2900°F) & low NO_x emissions 50-80 ppmv (3% O_2 dry), without a "DeNOx".
- ✓ ***What is the next step?***
- ✓ Looking for applications to convert **Ammonia** into heat with our **SCO Technology**