



Innovative Solution:

Tapping 4 times more energy from Acid Gases
Unique, Valuable, Proven

Sagar Shukla

Haldor Topsoe

How we proceed

- What can we do differently with H₂S
- Where it fits best from Indian perspective
- About the process
- Future of Acid Gas Management

Haldor Topsoe

In brief

- Market leader in heterogeneous catalysis for the refining and chemical industries for more than 75 years.
- 2,200 employees in 13 countries.
- Headquarters in Copenhagen, Denmark.
- Production in Frederikssund, Denmark, and Houston, US.
- Spends around 9% of revenue on R&D.
- Established in 1940 by Dr. Haldor Topsøe.
- Owned by the Topsøe family via Haldor Topsøe Holding A/S (70%) and Temasek (30%).

2018 revenue
DKK 5,617m
(~USD 890m)

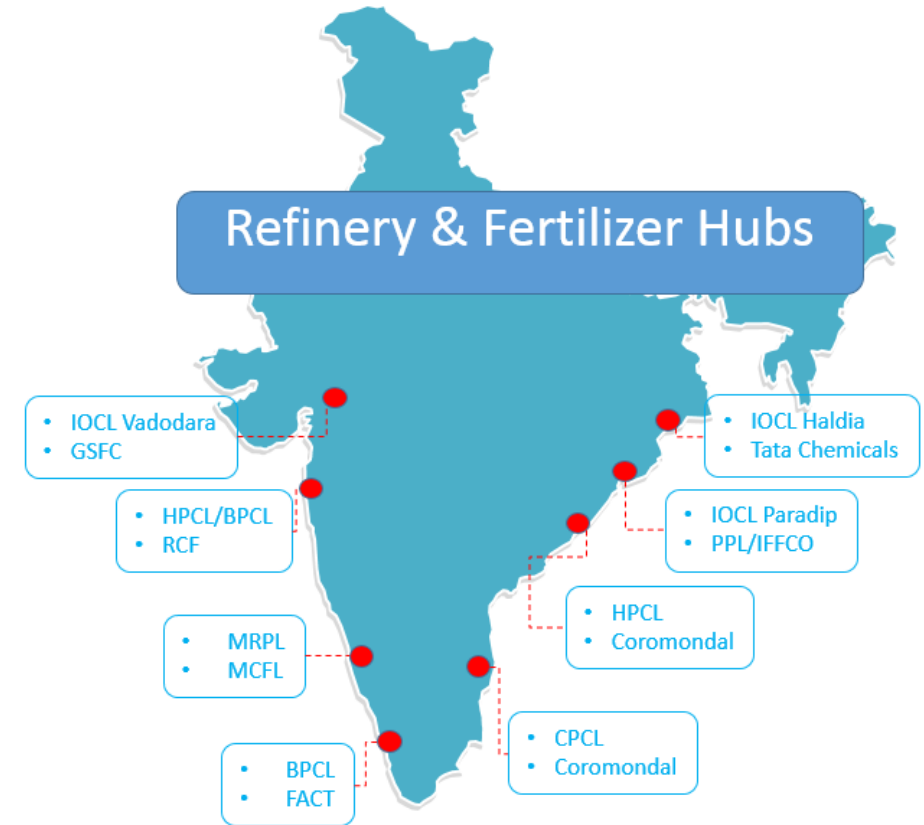
2018 operating
profit DKK 708m
(~USD 110m)

Concerns for Indian Subcontinent

- India is net Energy deficit
- India is net Sulfuric acid deficit
- India is struggling on rising Pollution Concerns

Some Other Facts:

- Maximum of Indian Refining and Phosphatic Fertilizer Production happens in Refinery-Fertilizer hubs
- Refiner use HC to produce HP Steam
- Fertilizer Plant use either Sulfur from Refinery or Import Sulfuric Acid for Phosphatic Fertilizer production



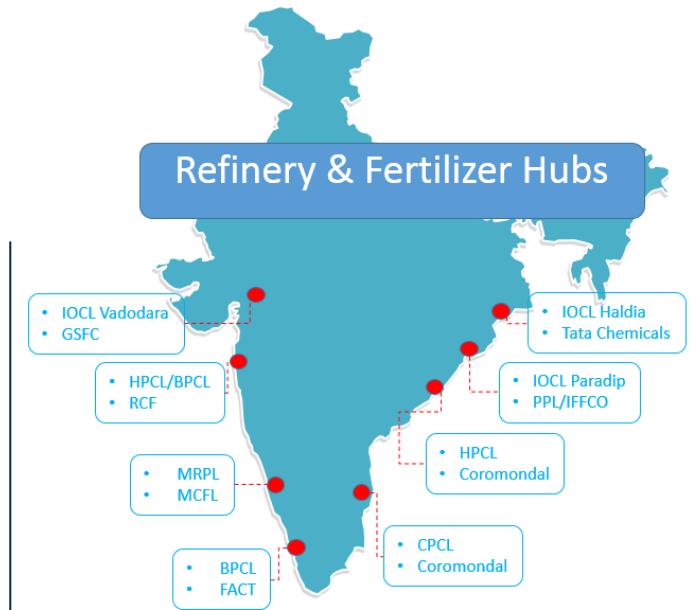
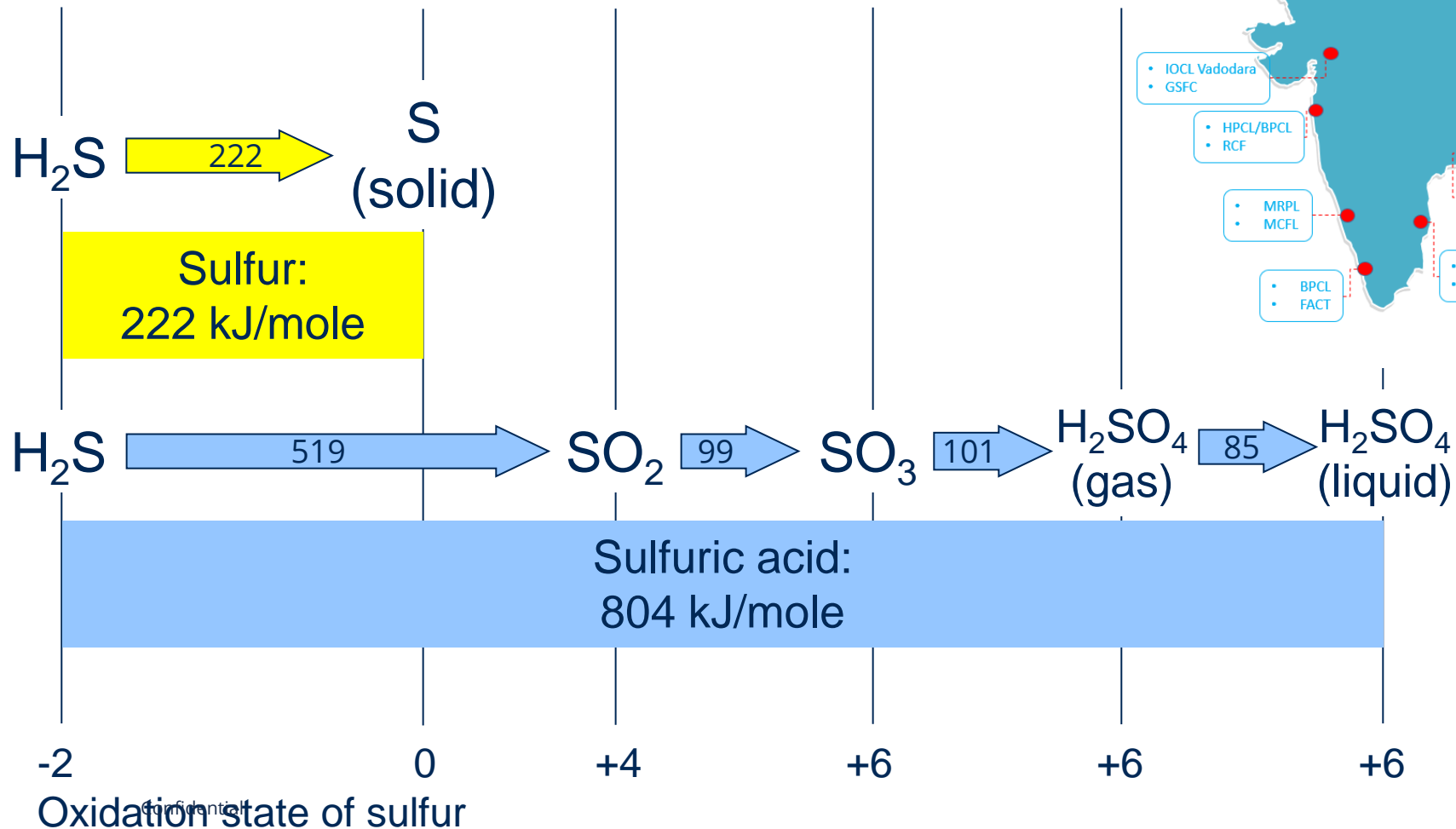
Can there be a better way:

- Where Refiner produce Energy from Waste
- Fertilizer gets cheap raw material
- Overall pollution in the region reduces?

The Process Principal: SRU vs Sulfuric Acid Solution

Value from Waste?

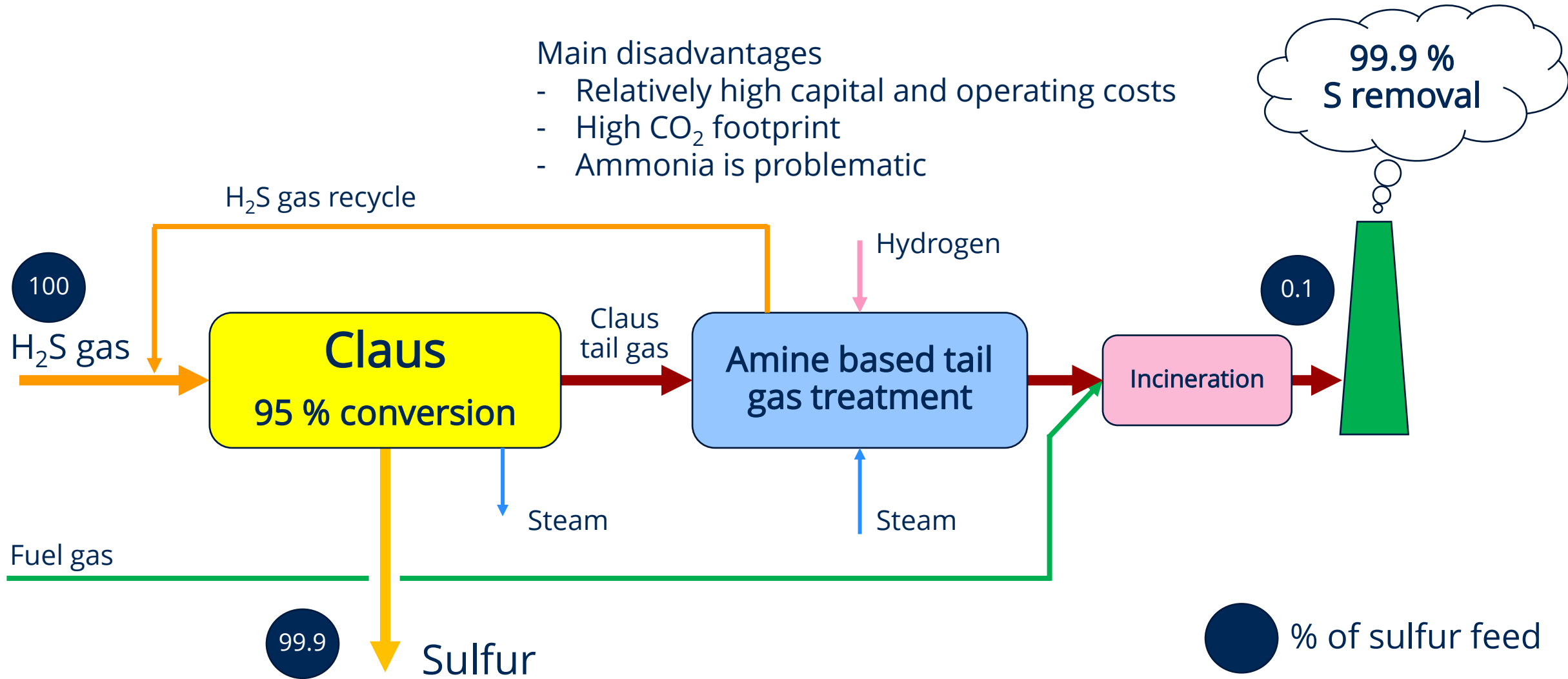
Tapping four times more energy from Acid Gases compared to that from SRU



Claus with conventional tail gas treatment

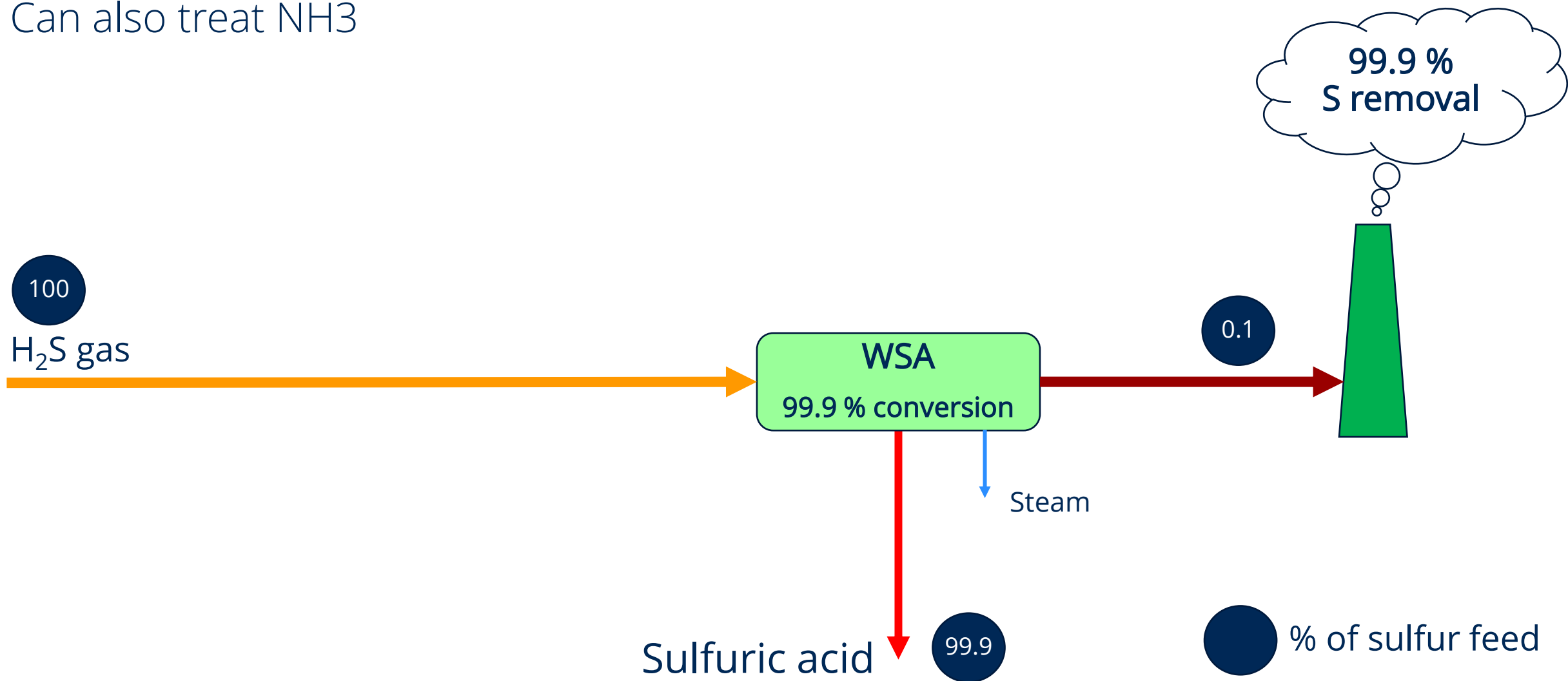
Main disadvantages

- Relatively high capital and operating costs
- High CO₂ footprint
- Ammonia is problematic



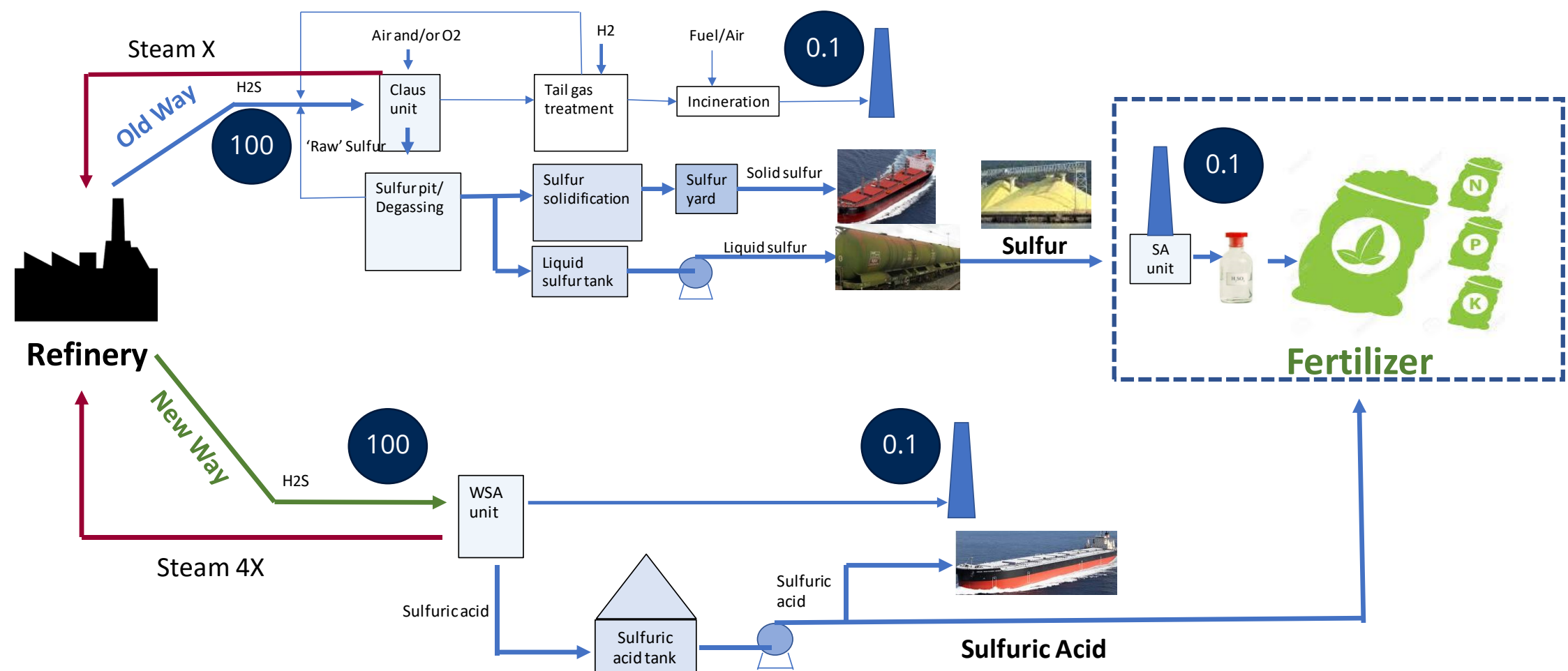
WSA

Can also treat NH_3



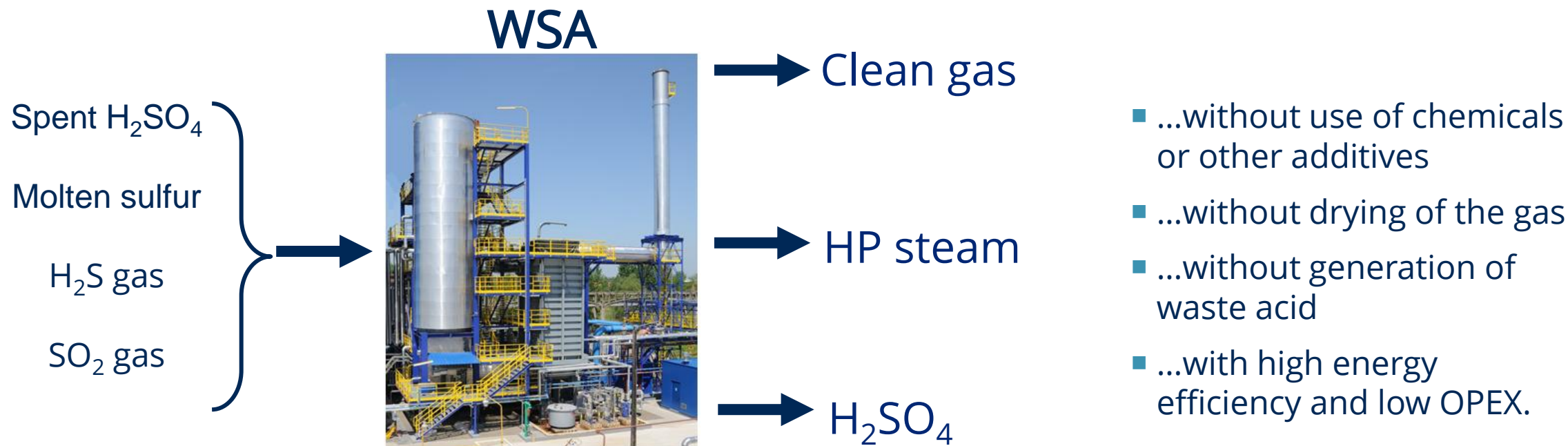
How this will look in hubs

Old way vs New way



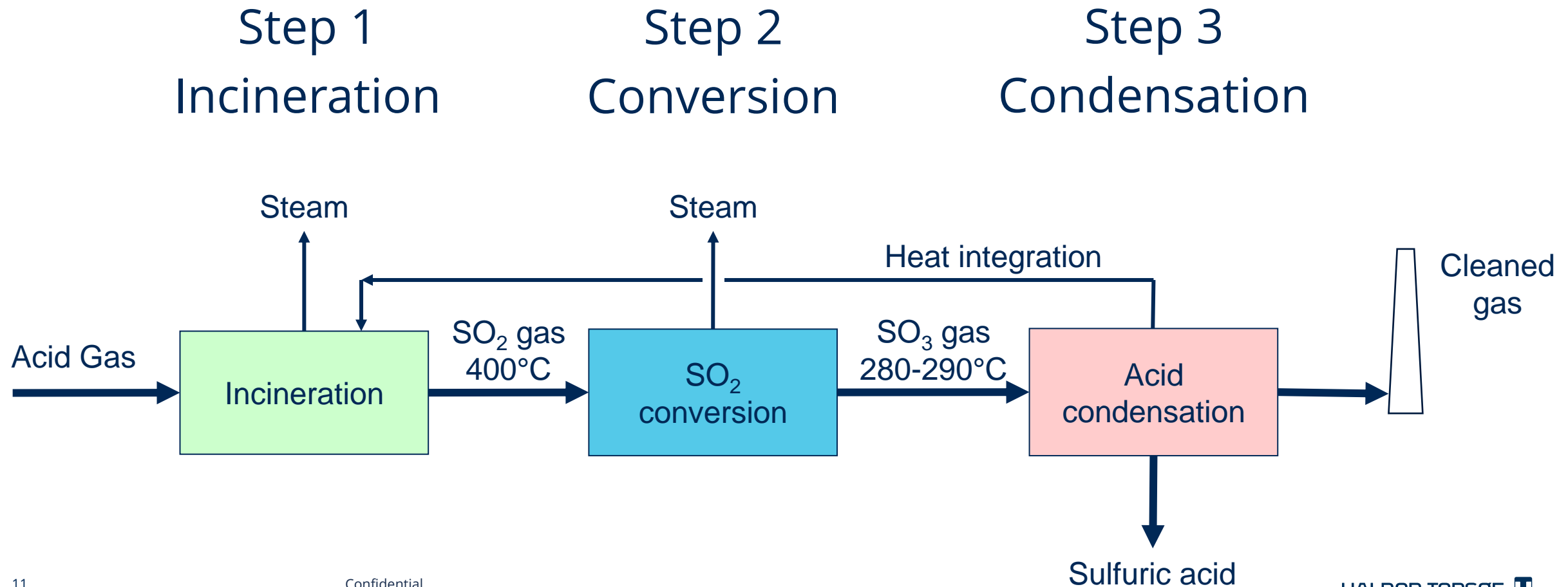
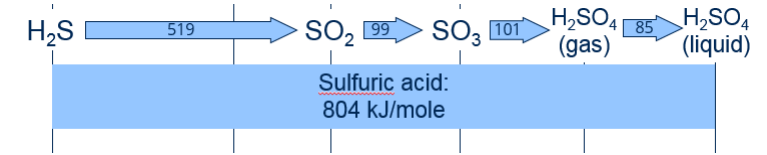
Wet gas Sulfuric Acid

A process for purification of sulfur containing streams under production of concentrated sulfuric acid

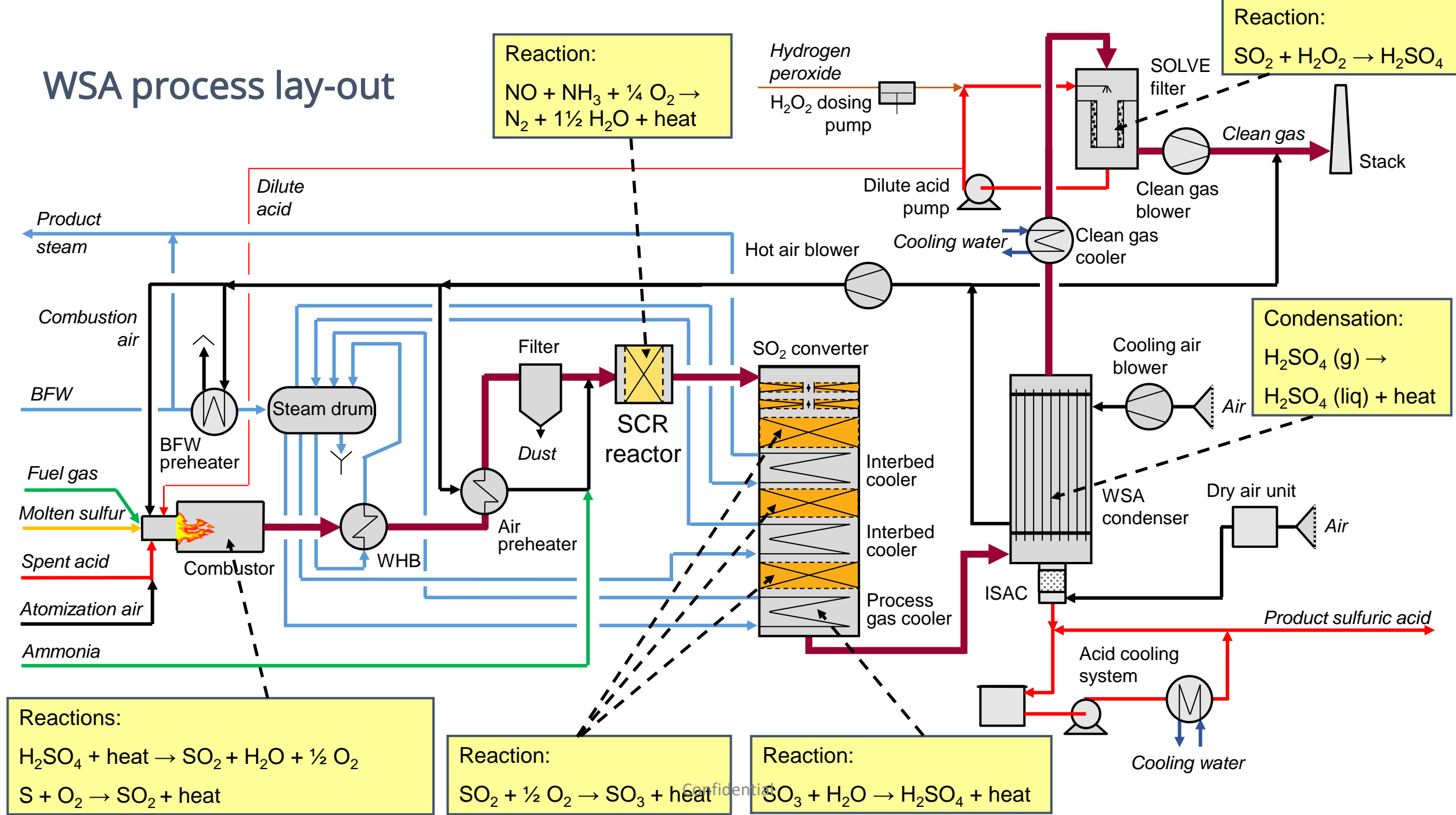


Walkthrough of the WSA process

Three simple steps



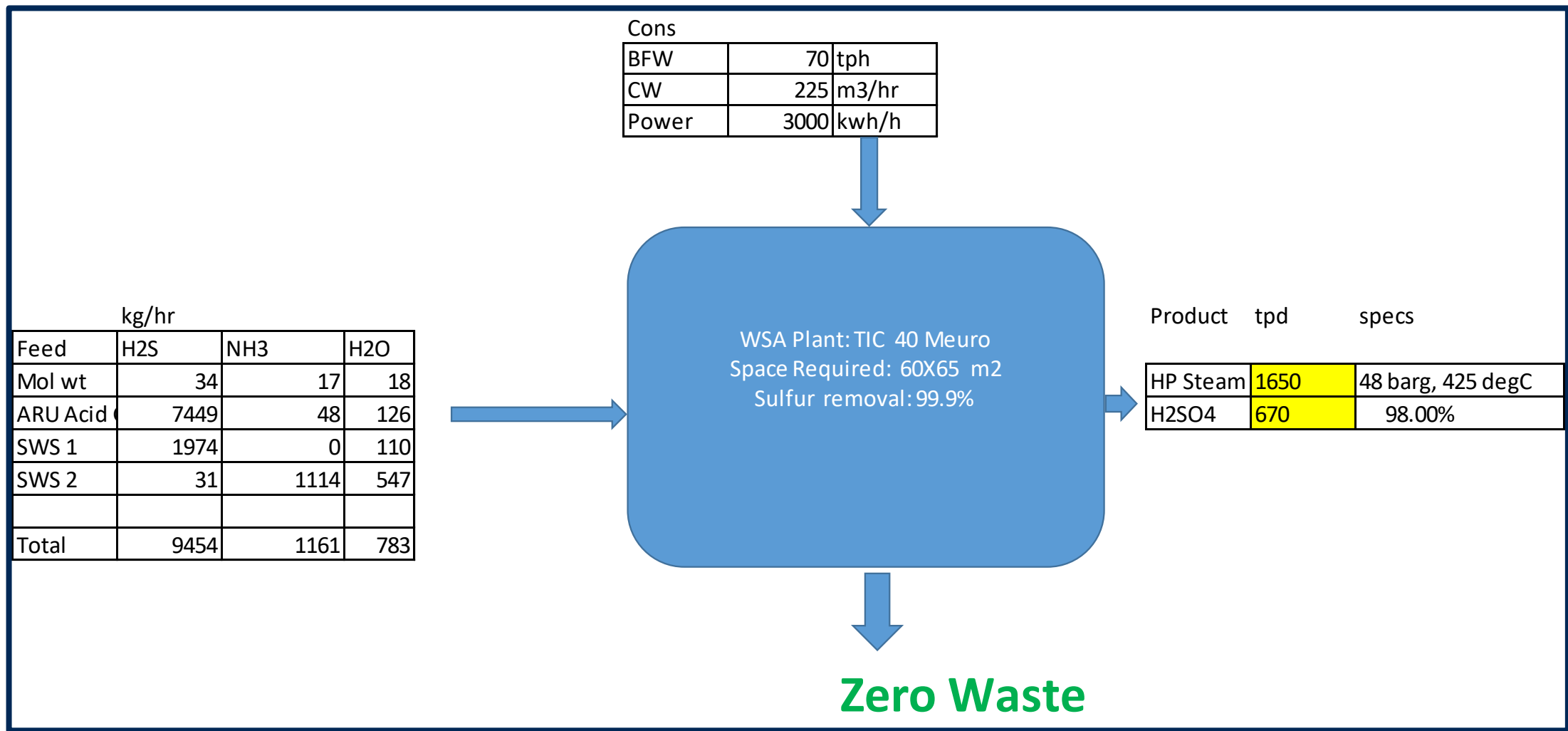
WSA process lay-out



WSA plant



Case Study: The Project Summary- Case Study



Production Figures

	UOM	Unit Price (INR)	WSA (Prod/Cons)		Claus + TGTU	
		INR	per day	lpa	per day	lpa
Production						
Sulfuric Acid	MT	1500.0	670	3467		
HP Steam	MT	2700.0	1650	15370		
MP Steam (15	MT	1800.0			413	2562
Sulfur	MT	6000.0			218	4507
Sales				18837		7069

Consumption & Operating Profit Figures

	UOM	Unit Price (INR)	WSA (Prod/Cons)		Claus + TGTU	
		INR	per day	lpa	per day	lpa
Cons						
Fuel Gas	MT	35000.0			7	898
BFW	MT	23.0	1680	133	421	33
MP Steam (15	MT	1800.0			103	640
CW	MT	2.0	6480	45		
Power	kwh	8.0	72000	1987	50400	1391
Cost of Sales				2165		2963
Operating Profit (lpa)				16672		4106

WSA/SNOX™ references

2019

Acid production: 4 – 1,140 MTPD
160+ references

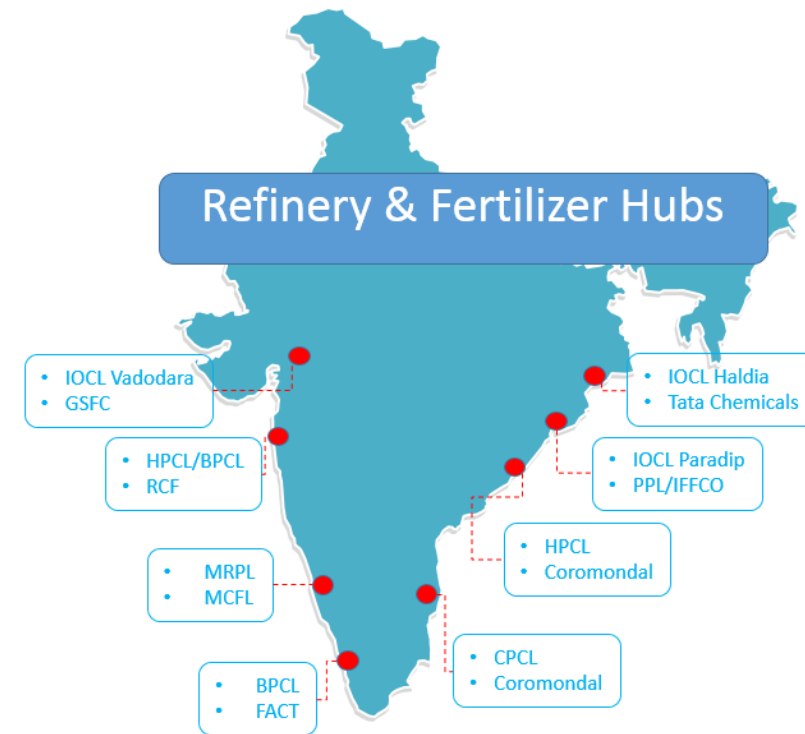


Summary:

Adaptation of Sulfuric acid Solution for Acid gas Management by Refiner

- This Solution is best fit in Refinery-Fertilizer Hubs for Refinery Acid Gas Mgmt.
 - Refiner extract maximum Energy from Waste
 - Refiner are able to send by-product (SA) to nearby Fertilizer Unit
 - Solution will reduce pollution by half in these Industrial regions

Creating the
most value, both
short term and long term



New Developments:

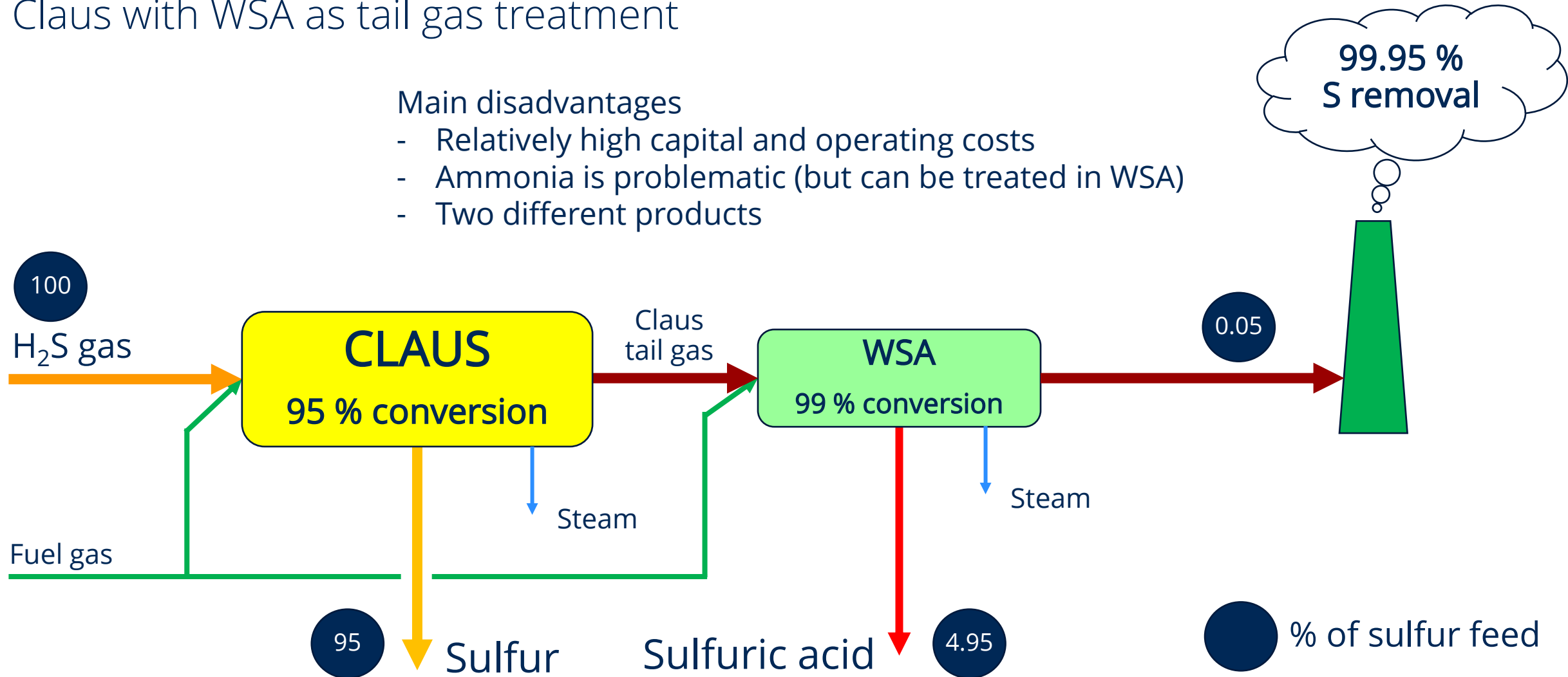
- Can WSA be used as substitute to TGTU in SRU?
 - For mix Sulfur & Sulfuric Acid Production
 - For only Sulfur Production

Claus + WSA

Claus with WSA as tail gas treatment

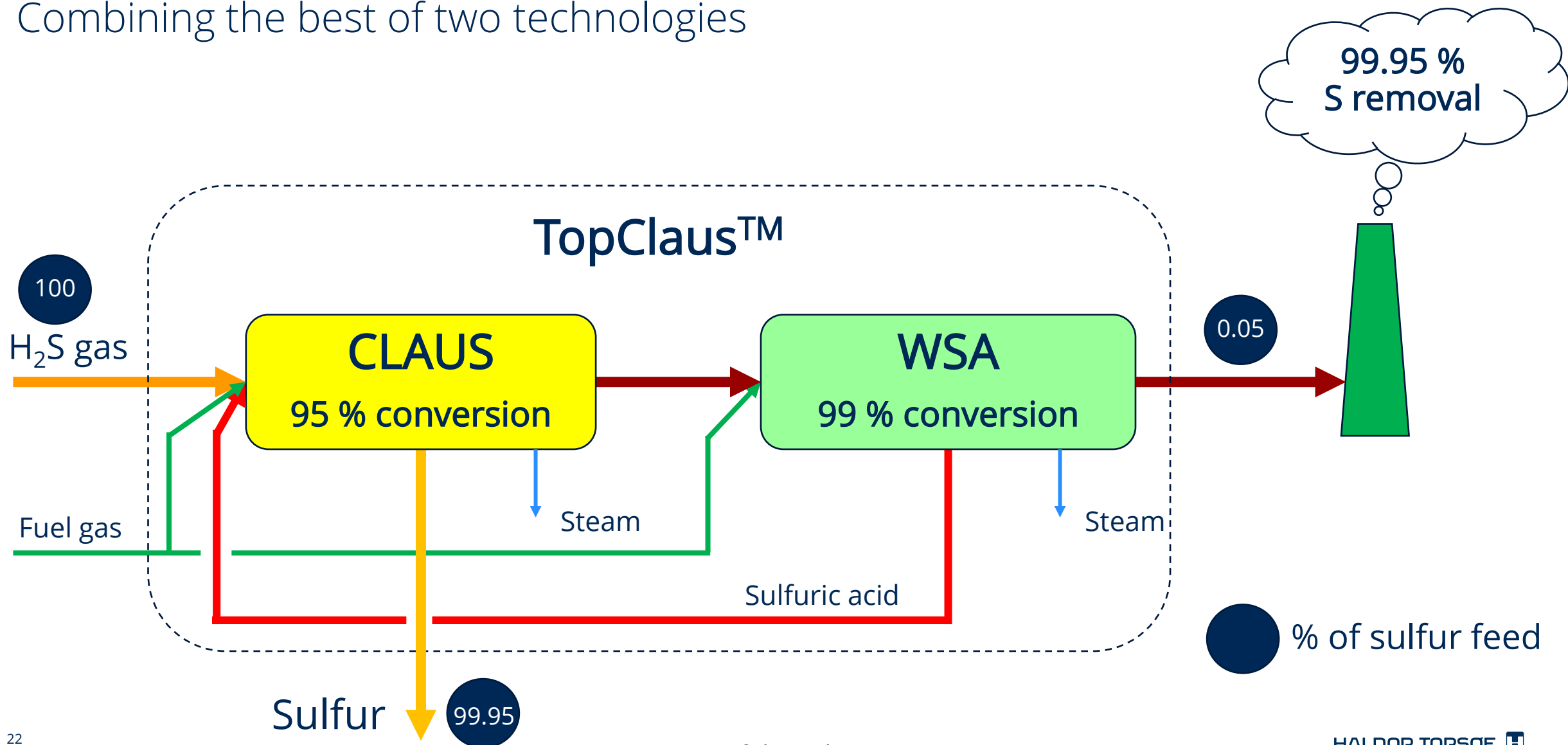
Main disadvantages

- Relatively high capital and operating costs
- Ammonia is problematic (but can be treated in WSA)
- Two different products



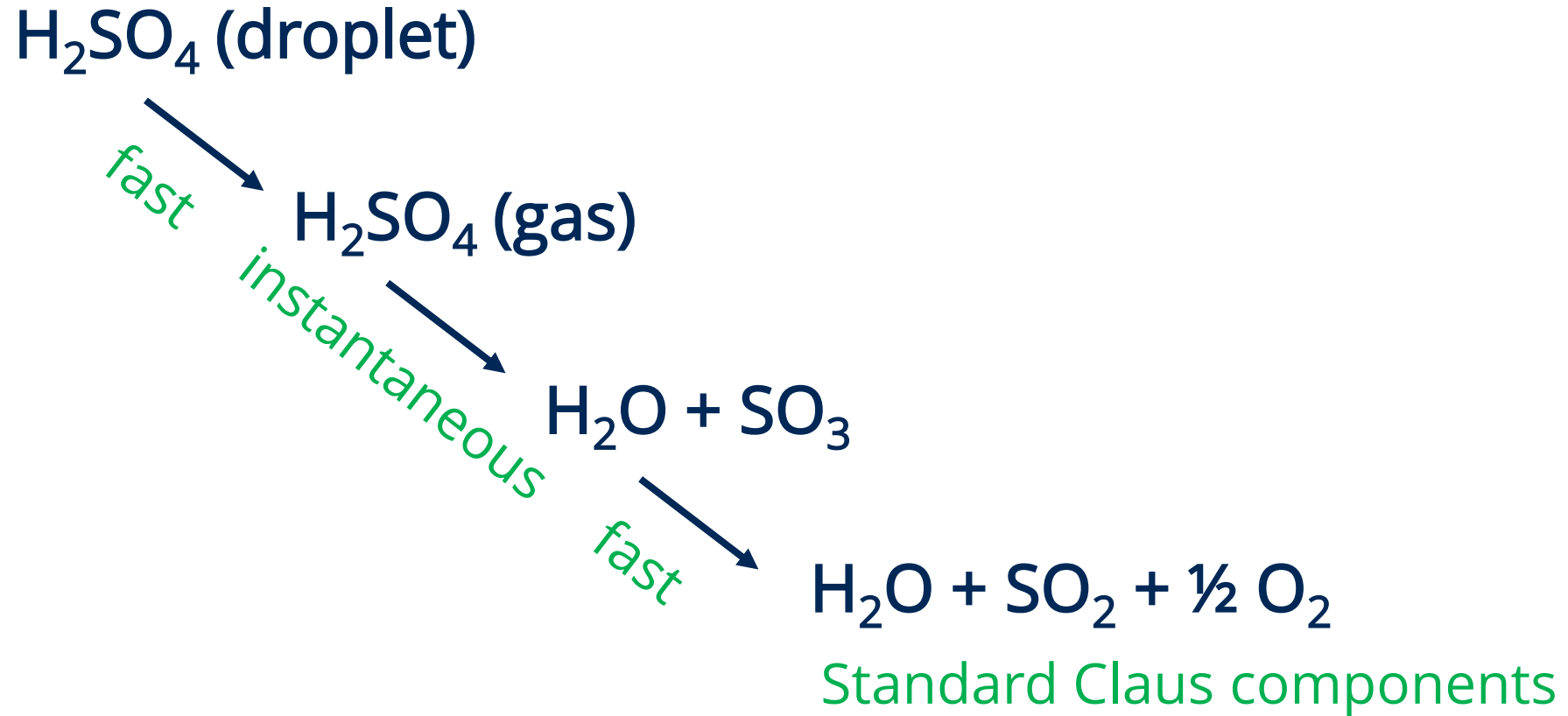
TopClaus™

Combining the best of two technologies



Claus reaction furnace chemistry

Fate of H_2SO_4



Claus reaction furnace chemistry

Claus capacity increase

Up to 16 % for 90 vol% H₂S gas feed

Overall Claus reaction with pure O₂



4 moles dilution gas

Overall Claus reaction with air



12 moles dilution gas

Overall Claus reaction with H₂SO₄



4.4 moles dilution gas

H₂SO₄ is an excellent oxygen carrier

Thank You



Traditional SRU

WSA technology – a simpler solution

- Contact for further information: sshu@topsoe.com