

Actual contribution of gases to the atmospheric greenhouse effect

<u>Greenhouse gas</u>	<u>Contr.</u>	<u>GWP100</u>	<u>Residence time</u>
water vapor (H ₂ O):	61.4 %		days
carbon dioxide (CO ₂):	20.5 %	1	50-200 a
methane (CH ₄)	7 %	23	9-15 a
laughing gas (N ₂ O):	6.8 %	310	120 a
ozone (O ₃)	2,3 %		
others (FCKW, SF ₆ ,)	2.0 %	22,000/SF ₆	3200 a/SF ₆

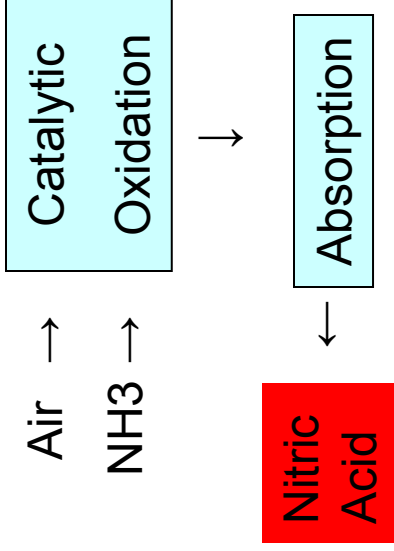
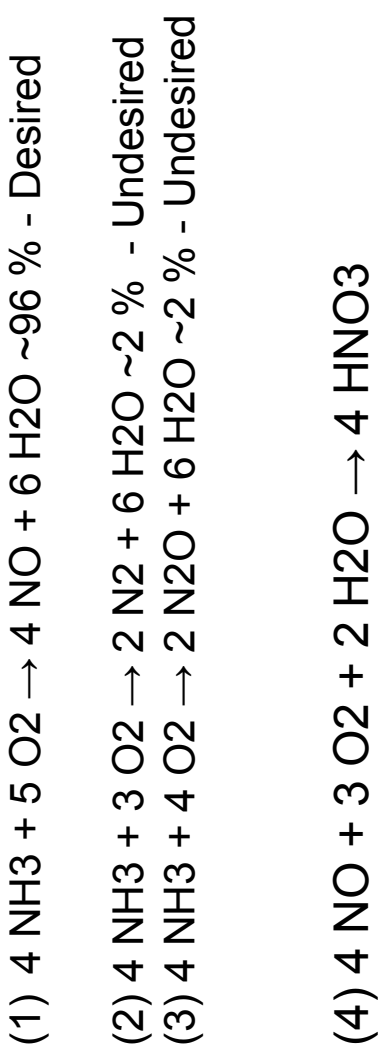
NOTE: Commercially available **Catalysts** can be used to eliminate N₂O, some industrial CH₄, and other high intensity GHG's

Source: Bayerisches Amt für Umweltschutz + IPCC

Where does N₂O Come From?

- N₂O contributes by about 6.8 % to atmospheric global warming
- Main sources are
 - Agriculture (major source); appr. 75 %
 - Adipic acid production
 - (can be significantly reduced by catalysts)
 - Automotive off-gas (three way catalysts); Pt !!; 15 %
 - Nitric acid production (largest industrial source); 5%
- 700 Nitric Acid plants worldwide
- 400.000 tpa N₂O or 125,000,000 tpa CO₂
- **Contributes appr. 0.3 % to the atmospheric global warming**

NOx/N2O formation in Nitric Acid production



Off-Gas

1000 - 2000 ppmv N2O; 200 - 600 ppmv NOx

- Amount of N2O formed: on average 7 kg N2O / t HNO3
- World wide emissions ~ 400,000 t N2O / a ; corr. 125 Mio t CO2
- HNO3 production now largest industrial process source of N2O
- GWP-Factor of N2O=310 (N2O/CO2)

Possibilities to reduce N₂O at Nitric acid plants

- **Primary (at ammonia oxidation site)**
 - N₂O is prevented from forming. Alternative catalysts are necessary, which may lead to lower selectivity for NO.
- **Secondary (directly after ammonia oxidation site)**
 - N₂O once formed, is removed anywhere between the outlet of the ammonia oxidation gauzes and
 - the inlet of the absorption tower. Influences the process.
 - Offered Commercially at several plants worldwide
- **Tertiary (end of the pipe)**
 - N₂O is removed from the tail gas downstream of the absorption tower by catalytic destruction.
 - Advantages are: no interference with the nitric acid production itself
process suitable for destroying N₂O **and** NO_x well accepted by plant operators