ScandeNOx & AAG Engineering Technologies

Concrete deNOx Solutions for Cement Plants
CONCRETE DENOX SOLUTIONS FOR CEMENT PLANTS

Project Financing

○ Do you need to comply with the “World Bank Guidelines” to get your project financed?
○ ScandeNOx can help you with the approval process by making an “Environmental Impact Assessment” of your project and help you interpret the applicable environmental legislation.

Operating Permit

○ Emission legislation can be difficult to interpret, and where the legislation makes exemptions for emissions derived from the raw materials, it can be difficult to prove to the relevant authorities that the emission of e.g. SO2 doesn’t stem from the burnt fuel or waste.
○ In such situations ScandeNOx can help with emission measurements and analyses to determine whether the emission in question is derived from the fuel or from the raw materials.
○ In one case a British cement plant wasn’t allowed to fire waste until it had been proven that the NOx emission limit could be met using conventional fossil fuel – even though the NOx emission was expected to decrease when waste fuel was used.
○ After some negotiating with the local environmental authorities, the cement plant was allowed to apply waste fuel, if it could be proven that the NOx emission over a 3 months period could be kept below the limit for fossil fuel by means of SNCR.
○ Within app. 2 weeks ScandeNOx personnel installed an SNCR system normally used for test purposes, upgraded it to semi-automatic operation and trained the plant staff in the correct operation and maintenance of the system. After 4 months the permit to fire waste was obtained.
ScandeNOx undertakes emission measurements with our own gas analysis equipment or by using vendors.

ScandeNOx’s founder & CEO, Chem. Eng. Claus Hjørnet, has performed SNCR tests with virtually all available reducing agents and enhancers on power plants, waste incineration boilers, cement plants, various industrial boilers and kupol ovens.

The tests were conducted in Denmark, Sweden, Finland, England, Ireland, Germany, Switzerland, Italy, Israel, India, Pennsylvania and Colorado, and in temperatures ranging from -30 to +40 °C.

Above: ScandeNOx measuring technician calibrating our TOC analyser.
SnCR test rig / temporary installation

- ScandeNOx’s state of the art injectors are superior to all other brands and have produced unsurpassed results in test applications as well as in permanently installed systems. Key elements of our injectors are constructed from heat resistant and/or wear resistant materials as the application requires, and are more durable than any other brand currently on the market.

The injector shown to the left is equipped with a "sliding tube" for an automatic retraction system as has been used on a number of SnCR systems for Waste-to-Energy plants in China.

- ScandeNOx’s SnCR expert has worked closely together with Nesher Israel Cement Enterprises for a number of years, and has conducted SnCR tests on all Nesher’s 3 kilns. All the tests resulted in orders for the permanent SnCR system, the last of which – at the Har Tuv plant - was commissioned in June 2015.
CONCRETE DENOX SOLUTIONS FOR CEMENT PLANTS

Choice of Chemical

• In wet and long dry kilns urea based SNCR systems can be used, but in preheater pyro systems the temperature is usually too low for urea solution so ammonia solution must be used.

• ScandeNOx delivers SNCR systems for concentrated and dilute solutions of technical urea or ammonia as well as ammonia-/urea-containing waste water of biological or industrial origin.

Combustion modifications or SNCR?

At an Italian cement plant the NOx emission used to be kept below the legal limit by means of high temperature combustion (“Hot Bottom Calciner” operation). However, the consequence of this operational mode was:

- Higher flue gas temperature at the preheater exit
- Limited fan capacity due to the elevated temperature
- Lower clinker production due to the limited fan capacity
- Higher specific fuel consumption

○ Extensive use of shock blasters and Cardox cleaning
○ Frequent kiln stops due to cyclone blockages / riser pipe deposits
○ High maintenance costs

To evaluate the possibilities, a study was conducted involving emission measurements during high temperature operation and low temperature operation with NOx reduction by means of SNCR.

This study showed that if high temperature operation was abandoned, the consequent lower heat consumption, lower maintenance cost and increased clinker production could easily pay for the cost of reducing the NOx emission by means of SNCR.
SNCR systems optimised for cement kilns

1. ScandeNOx's superior injection technique in combination with a unique control concept allows us to achieve good mixing and follow load variations without using dilution water.

2. This not only means that no pumps, buffer tanks or demineralising units for water are required, it also means less water and power consumption, less maintenance, no consumption of chemicals / ion exchange resin, less fan work and lower flue gas dew point.

3. Since concentrated ammonia solution contributes positively to the heat input, the fuel input can be reduced accordingly, and the injected chemical and atomisation air thus doesn't cause any reduced temperature or increased flow of the combustion gases.

4. Another unique feature of ScandeNOx's SNCR systems for cement plants is the modules used for dosing and distributing the reducing agent. Where most of our competitors use skid-mounted “control- and measuring modules” and “injection modules”, ScandeNOx assembles the mechanical components needed for control and surveillance purposes in water- and dust proof (IP54) cabinets.
SNCR systems optimised for cement kilns

For small systems, or systems where small separate groups of injectors are used, all the components for control and surveillance are assembled in “Dosing & Distribution Modules” consisting of IP54 cabinets for the mechanical parts which also contain separate IP65 cabinets for the electrical components:

The main advantages of ScandeNOx’s SNCR systems for cement plants are thus:

- no dilution water means low cost of installation, operation and maintenance, reduced risk of dew point corrosion, no need for insulation and heat tracing for frost proofing
- no increase in flue gas flow, no drop in flue gas temperature, no unnecessary heat or power consumption
- unique injectors featuring unsurpassed performance and durability
- shop tested modules in dust- and water proof cabinets with separate IP65 enclosures for electronics

... and the best possible technical service and consultancy in English, German or Danish/Scandinavian.
ScandeNOx specialises in combining not only reagent sources, but even catalytic and non-catalytic techniques to “kill the most birds with one stone” for our Clients.

In Power Station Baqiao, China, ScandeNOx personnel combined State of the Art SNCR technology with Selective Catalytic Reduction – a concept that can also be used on cement kilns:

**SN+CR**

On cement plants with a high baseline ammonia emission and/or a high SO2 emission, an SCR catalyst may be required to avoid visible plumes, dew point corrosion and deposits of ammonium bisulphate in filters / on fans and it may even solve problems with emissions of VOC, TOC, PAH or Dioxins/Furans.

How to...
- control cement kiln temperature without a NOx signal
- reduce NOx in cement kiln bypasses
- Install a deNOx system without stopping the kiln

ScandeNOx has personnel with the experience to answer all such questions and the expertise to advise our Clients on current, emerging and future technologies.
## PROJECTS EXECUTED

### WASTE TO ENERGY BOILER PROJECTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Location</th>
<th>Details</th>
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<tbody>
<tr>
<td>3 sets of new improved injectors for Hangzhou, China</td>
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<td>2 x SCR Reagent Storage &amp; Injection Systems, Amager Bakke, Denmark</td>
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<td>3 x SNCR injectors of new design for 3 x MSW boilers, Pinghu I, China</td>
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<td>SNCR NH4OH for Ningbo, China, 600 tpd MSW boiler, Sanfeng Covanta</td>
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<td>3 x SNCR NH4OH for Hangzhou, China, 3 x 200 t/d MSW boiler, Tianlan</td>
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<td>2 x SNCR NH4OH for Changtai #1 - 2, China</td>
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<td>2 x 280 t/d MSW CFB, Tianlan</td>
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<td>2 x SNCR NH4OH for Yuhang, China</td>
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<td>2 x 35 t/h MSW boiler, Haiyuan</td>
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<td>SNCR NH4OH for Fuchunjiang #2, China</td>
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<td>MSW boiler, Fuchunjiang</td>
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<td>3 x SNCR NH4OH for Dalian, China</td>
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<td>3 x 500 t/d MSW boiler, Hitachi</td>
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<td>3 x SNCR NH4OH for Pinghu, China, 3 x MSW boiler, Pinghu I</td>
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<td>4 x SNCR Urea for Fengsheng, China</td>
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<td>4 x MSW boiler, Covanta</td>
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<td>3 x SNCR NH4OH for Grandtop, China, 3 x 500 t/d MSW boiler, Grandtop Group</td>
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<td>SNCR NH4OH for Esbjerg L90, Denmark</td>
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<td>30 t/h MSW boiler SNCR NH4OH for Sornival, Nevers, France</td>
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<td>15 t/h MSW boiler 4 x SNCR NH4OH for Amagerforbraending #1 - 4, Denmark</td>
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<td>4 x 12 t/h MSW boilers SNCR Tests at Vestforbraending #3, Denmark</td>
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<tr>
<td>12 t/h MSW boilers SNCR NH4OH for Vestforbraending #5, Denmark, 26 t/h MSW boiler</td>
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### CEMENT KILN PROJECTS

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<tr>
<th>Description</th>
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<tbody>
<tr>
<td>SNCR NH4OH for Har Tuv, Israel, 1600 tpd Lepol Grate Kiln, Nesher Israel Cement Enterprise</td>
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<td>SNCR NH4OH for 3202 tpd grey cement kiln #3 at Cimentos Izmir, Turkey</td>
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<td>SNCR NH4OH for 2169 tpd grey cement kiln #1 at Cimentos Izmir, Turkey</td>
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<td>SNCR NH4OH for 1250 tpd grey cement kiln at Cimentos Kars, Turkey</td>
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<td>SNCR NH4OH for 4500 tpd grey cement kiln at Adana Cement, Turkey</td>
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<td>SNCR NH4OH for 900 tpd white cement kiln at Adana Cement, Turkey</td>
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<td>SNCR NH4OH for Hubei, China, 5000 tpd ILC Cement Plant, Hubei Cement Plant SNCR NH4OH for Xiling, China, 2500 tpd ILC Cement Plant, Xiling Cement plant</td>
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<td>SNCR NH4OH for Jinyin, China, 4000 tpd ILC Cement Plant, Jiehua</td>
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<td>SNCR NH4OH for Jinglan, China, 4000 tpd ILC Cement Plant, Jiehua</td>
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<tr>
<td>SNCR NH4OH for Jutai, China, 2000 tpd ILC Cement Plant, Zhejiang Design Institute</td>
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<td>SNCR NH4OH for Shangfeng, China, 2500 tpd ILC Cement Plant, Haiyuan Environmental Co.</td>
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<td>SNCR NH4OH for Yunshi, China, 2900 tpd ILC Cement Plant, Shaoshan</td>
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<td>2 x SNCR NH4OH for Esheng # 1 - 2, China, 2 x 5000 tpd ILC Cement Plant, Jiehua</td>
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<tr>
<td>SNCR NH4OH for Jingshan, China, 2500 tpd ILC Cement Plant, Nanda</td>
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PROJECTS EXECUTED

CEMENT KILN PROJECTS

- SNCR NH4OH for Changshan, China, 5500 tpd ILC Cement Plant, Zhejiang Design Institute
- SNCR NH4OH for Nanyan, China, 1500 tpd ILC Cement Plant, C-Hope
- SNCR NH4OH for RDL 1, 6000 tpd SLC Cement Plant, Nesher Israel Cement Enterprises Ltd.
- SNCR Upgrade for RDL 2, 6000 tpd SLC Cement Plant, Nesher Israel Cement Enterprises Ltd.
- SNCR NH4OH for Djebel Ressas, Tunesia, 5800 tpd ILC Cement Plant
- SNCR NH4OH for OJSC Shurovsky Cement, Russia, 5500 tpd ILC Cement Plant
- SNCR NH4OH for Grupa Osarow S.A., Poland, Kiln2, 7000 tpd ILC Cement Plant
- SNCR NH4OH for Cementos Molins Industrial S.A., Spain, 4100 tpd ILC Cement Plant
- SNCR NH4OH for St. Genevieve MA, USA, 12000 tpd ILC Cement Plant (Sale only)
- SNCR NH4OH for Nesher Israel Cement Enterprises Ltd., RDL 2, 6000 tpd SLC Cement Plant
- SNCR NH4OH for Spenner Zement G.m.b.H & Co. KG, Germany, Kiln 2, 2800 tpd ILC Cement Plant
- SNCR NH4OH for Production Association Kokshe Cement, Khazakstan, 5500 tpd ILC Cement Plant

POWER PLANT & INDUSTRIAL BOILER PROJECTS

- Low-budget SNCR Urea for 25 tph biomass-fired boiler, Neame Lea #1, UK. Order start 2019.06.01
- 2 x SNCR Urea for 2 x 8 MW biomass-fired boilers, Neame Lea #2&3, UK. Order start 2019.06.01
- 2 x SNCR NH4OH for 2 x 15 MW biomass-fired boilers, Aminteo, Greece. Order start 2019.03.18
- 2 x SNCR Urea for 2 x 20 MW biomass fired boilers, Imantas, Latvia. Order start 2019.01.25
- Micro SNCR Urea for Datatherm biomass boiler, Slovakia
- 2 x Micro SNCR Urea for 2 x 25 tph biomass boilers Kangshifu, China
- Micro SNCR Urea for biomass boiler Seda Olam, Spain
- SCR Reactor, Mixer & Catalyst, Delayed Coker, Kilburn Engineering, India
- 2 x SNCR NH4OH for 2 x 116 MW CFB boilers at Changchun, China SNCR NH4OH for 234 t/h CFB boiler at Stora Enso Guangxi Forest Pulp-and-Paper, China
- SNCR NH4OH for 220 t/h CFB boiler at Xiamen, China
- 3 x SNCR NH4OH for 3 x 75 t/h CFB boilers at Zhongche Rubber, China
- 2 x SNCR NH4OH for CBB & CFB boilers at Zhongche Jiande, China
- 4 x SNCR NH4OH for Nordic Sugar, Denmark, oil & gas fired boilers, Nordic Sugar
- 4 x SCR Reagent Injection Systems, HRSG, B D Heat, USA
- 1 x SCR Injection System, Boiler, B D Heat, USA
- SNCR Urea for Haerbin, China, Haerbin Boilers
- SNCR NH4OH for Dushanzi, China, 410 t/h CFB, Tianlan
- 3 x SNCR NH4OH for Hongbao, China, 3 x 130 t/h CFB, Hongbao
PROJECTS EXECUTED

POWER PLANT & INDUSTRIAL BOILER PROJECTS

- Micro SNCR Urea for Morgan Sindall 350 kW biomass boiler, UK, Peerless
- 2 x SN+CR NH4OH for Daelim, Saudi Arabia, Thermax India
- 2 x SCR for 85 t/h Off Gas Fired Boilers, Takreer, Abu-Dhabi Oil Refinery, Thermax India
- SNCR NH4OH for Zhejiang Jiahua Chem. #1, China, 450 t/h CFB, Jiehua
- SNCR NH4OH for Zhejiang Jiahua Chem. #2, China, 450 t/h CFB, Jiehua
- 3 x SNCR NH4OH for Zhejiang Jiahua Chem. #4 - 6, China, 3 x 450 t/h CFB, Jiehua
- 3 x SNCR NH4OH for Liaocheng #1 - 3, China, 3 x 130 t/h CFB, Tianlan
- SNCR NH4OH for Runtu #1, China, 150 t/h CFB, Tianlan
- 2 x SNCR NH4OH for Haiheng #2 - 3, China, 2 x 75 t/h CFB, Tianlan
- 3 x SNCR NH4OH for Ji’an #1 - 3, China, 3 x 130 t/h CFB, Tianlan
- 2 x SNCR NH4OH for Ji’an #4 - 5, China, 2 x 150 t/h CFB, Tianlan
- 2 x SNCR NH4OH for Yanjiang #1 - 22, China, CFB, Covanta
- 3 x SNCR NH4OH for Yongtai #1 - 3, China, CFB
- SNCR NH4OH for Sanxing #8, China, 220 t/h CFB
- 4 x SNCR NH4OH for Sanxing #4 - 7, China, 4 x 150 t/h CFB
- 3 x SNCR NH4OH for Sanxing #1 - 3, China, 3 x 130 t/h CFB
- 4 x SCR Reagent Injection Systems, HRSG, B D Heat, USA
- 1 x SCR Injection System, Boiler, B D Heat, USA
- SNCR NH4OH for Fushunjiang #9, China, 240 t/h CFB
- SNCR NH4OH for Fushunjiang #6, China, 240 t/h CFB 2 x SNCR NH4OH for Fushunjiang #3 - 4, China, 2 x 240 t/h CFB
- SNCR NH4OH for Xinjiang Chuanning, China, 240 t/h CFB
- 2 x SNCR NH4OH for Xinjiang Chuanning #1 - 2, China, 2 x 410 t/h CFB
- SNCR NH4OH for Fushunjiang #9, China, 240 t/h CFB SNCR Urea for Shuangzhou #2, China, 240 t/h CFB
- SNCR Urea for Kholbach, Italy, Biomass Power Plant
- 2 x SN+CR for Baqiao, China, 2*300 MWe Power Plant
- SNCR Urea for Laiwu, China, 2*300 MWe Power Plant
- SNCR NH4OH for Ljungby, Sweden, gratefired industrial boiler, wood chips
- SNCR NH4OH for Enköping Energi AB, Enakraft (H&P), Sweden, 25 MWe, wood chips on grate
- SCR Demonstration plant, 10.000 Nm3/h, Highdust, Lowdust, Slipbrake, Stigsnsæsværket, Denmark
- SNCR NH4OH for Rockwool International, Aquila, Denmark, 10 tpd Rockwool Plant

MISCELLANEOUS PLANTS

- SNCR NH4OH for 18000 Nm3, @/h glass furnace at Jushi Chendu, China
- R&D Project “SNCR Enhancers & Additives”
- SNCR NH4OH for Rockwool International, Aquila, Denmark, 10 tpd Rockwool Plant

WASTE-TO-ENERGY BOILERS, MISCELLANEOUS PROJECTS

- R&D Project, Furnace Temperature Control, Knudmoseværket, Denmark
- Temperature Control System, I/S REFA Kraftvarmeværk, Nykøbing Falster, Denmark
CEMENT KILNS, MISCELLANEOUS PROJECTS

- Consultancy re. Ammonia Dilution System, Nesher Israel Cement Enterprises Ltd.
- SNCR Tests at Shree Cement Ltd., Beawar, India
- Conceptual Design & Pricing, Urea Dissolving Plant, Har Tuv Cement, Israel
- Emissions audit Report, Ballyconnell Plant, Quinn Cement, Ireland
- SNCR Tests, Har Tuv Site, Nesher Israel Cement Enterprises Ltd.
- Parametric SNCR Tests on RDL 1, Nesher Israel Cement Enterprises Ltd.
- SNCR Pre-Engineering for Quinn Cement Ltd., Ireland, Kiln 2, 4200 tpd ILC Cement Plant
- SNCR Tests at Finnsementti, Lappeenranta, ILC, Finland

POWER PLANTS, MISCELLANEOUS PROJECTS

- SNCR NH4OH tests on front wall fired boiler at Asnæsværket, Denmark, 144 MWe, coal
- SNCR NH4OH tests on tangentially fired boiler at Skærbækværket, Denmark, 392 MWe, gas
- SN+CR Feasibility Study for Uppsala Energi AB, Fyriskraft Power Plant, Sweden, 100 MWe, peat-fired
- SNCR Development Project at Fyriskraft, Uppsala, Sweden, 100 MWe, peat-fired
- SNCR Urea Tests at Uppsala Energi AB, The Hot Water Central, Sweden, 100 MWfuel, peat-fired
- SCR Project Study, Coal-fired Power Plant Unit #4, Vesterås, Sweden
- SCR Project Study, Coal-fired Power Plant Unit #2, NEFO, Elsam, Denmark
- SCR Project Study, 225 MWe + 330 MWt Coal-fired, Avedøreværket #1, Elkraft, Denmark
- SNCR Urea Tests at ASM Brescia, Lamarmora unit no.1, Italy, oil-fired utility boiler
- SCR Demonstration at Asnæs Power Station, unit no. 4, Denmark, 265 MWe, coal-fired with lowNOx-burners
- SNCR Urea Tests at Asnæs Power Station, unit no. 3, Denmark, 265 MWe, coal-fired

Projects carried out by ScandeNOx’s CEO for ScandeNOx
Projects carried out by ScandeNOx’s CEO while employed by Babcock & Wilcox Vølund
Projects carried out by ScandeNOx’s CEO while employed by Flow.Visio
Projects carried out by ScandeNOx’s CEO while employed by FLSmidth
## CONTACTS AND ENQUIRIES

<table>
<thead>
<tr>
<th>Email</th>
<th><a href="mailto:sales-south@aagengg.com">sales-south@aagengg.com</a> / <a href="mailto:aagenggtech01@gmail.com">aagenggtech01@gmail.com</a></th>
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<tbody>
<tr>
<td>Contact Number</td>
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<tr>
<td>Know more</td>
<td><a href="http://www.scandenox.dk">www.scandenox.dk</a> / <a href="http://www.aagengg.com">www.aagengg.com</a></td>
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**AAG ENGINEERING TECHNOLOGIES PVT. LTD.**

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Thank you

ScandeNOx
&
AAG Engineering Technologies