NEXTCHEM | STAMICARBON

FROM LAUNCH TO NEXT LEVEL

RELY ON OUR FULL SUPPORT THROUGHOUT
THE LIFECYCLE OF YOUR UREA PLANT

NX STAMI™ UREA

WHAT ARE THE BIG CHALLENGES?

Fertilizers like urea provide essential nutrients.

INTRODUCTION

The United Nations expects the global population to hit 9.7 billion by 2050. The yield from arable land is not growing at the same pace. Increasing prosperity worldwide is also driving increasing demand for fertilizers. It all adds to greater pressure on our farming infrastructure.

Feed the world

Creating the right conditions for food security will mean improving agricultural production, increasing crop yields, and farming in ever more sustainable ways. Fertilizers like urea provide the essential nutrients that crops need to grow strong and fight off disease.

The challenges the fertilizer industry faces to maintain air and soil quality for future generations are just as weighty. As pioneer **with a higher purpose we believe our technology can help the world feed itself and improve quality of life.** So how can our plant engineering and construction services help you meet these challenges?

Content

HOW WE HELP YOU

We help you find
the right technologies.

WE ARE LEADERS IN UREA

Stamicarbon is **world market leader in urea plant design, licensing and construction.** Through our Stami Urea business unit we apply our expertise, knowledge and experience to help you identify the best technologies to improve the efficiency of your fertilizer production, emission reduction and process integration. From creating a new plant to optimizing and upgrading existing facilities, we are there for you every step of the way in your quest for sustainable, futureproof production. And throughout the whole lifecycle of your plant.

UREA, A POPULAR CROP NUTRIENT AND FERTILIZER

So why is urea such a big deal? Why is this fertilizer such an important crop nutrient? Well, crops need to take up nutrients directly from the soil to grow. These nutrients need to be replenished to maintain a rich and fertile growing environment. Otherwise crop production can stagnate or even cease. That's where urea comes in.

Eureka! Urea

Urea was discovered "accidently" in 1828, while German chemist Friedrich Wöhler was trying to synthesize ammonia cyanate. This discovery opened the door to modern nitrogen fertilizer industry

A white crystalline organic compound synthesized from natural gas and air, through derivatives ammonia and carbon dioxide, urea has a high nitrogen content (around 46%), making it an important nitrogen-based fertilizer. The vast majority of urea is used as a fertilizer to increase crop yield. Some 200 million tons of urea is produced every year and more than 80% of it is used to fertilize crops.

A fast-growing market

As demand for urea keeps growing, **new urea plants are needed and older plants need to be upgraded to modern standards.** Stamicarbon can help you tackle all the challenges faced when developing and building a new plant. We have the most advanced solutions and comprehensive support to guide you through the whole process of designing and developing state-of-the art urea production facilities.

UREA IS THE WORLD'S MOST USED FERTILIZER.

LICENSING STATE-OF-THE-ART UREA PLANTS

Our engagement and commitment to your new urea plant do not end once it is commissioned We have developed an extensive portfolio of technologies, products and services for urea plants. Our high-quality standards and **full lifecycle philosophy** set us apart from the competition.

Benefit from our full service
We provide bespoke technological solutions, products and services that meet all your requirements, with continuous **support throughout the lifecycle of your plant**, regardless of its age. Our **three series** – **LAUNCH**, **ADVANCE** and **EVOLVE** meet a wide range of real world needs.

The lifecycle of your plant starts with the LAUNCH phase: design and engineering to procurement and ultimately construction. The next phase is ADVANCE. Here, the power of our products and services to optimize the performance of your plant comes to the fore. We also have the knowledge and latest urea technology designs you need to EVOLVE your plant to the next level.

We provide technological solutions, products and services that meet all your requirements.

LAUNCH™

Creating your plant

Launch a new plant, with all the technologies, products and services needed for successful, sustainable and profitable urea production.

Solutions for melt synthesis
Solutions for urea finishing

ADVANCE™

Optimizing your plant

Advance your plant performance, reduce downtime, improve product quality and increase efficiency with these products and services:

Support and plant staff training
Optimizing plant output and operation control
Improving product quality
Improving safety and reducing environmental impact
Inspections and plant maintenance

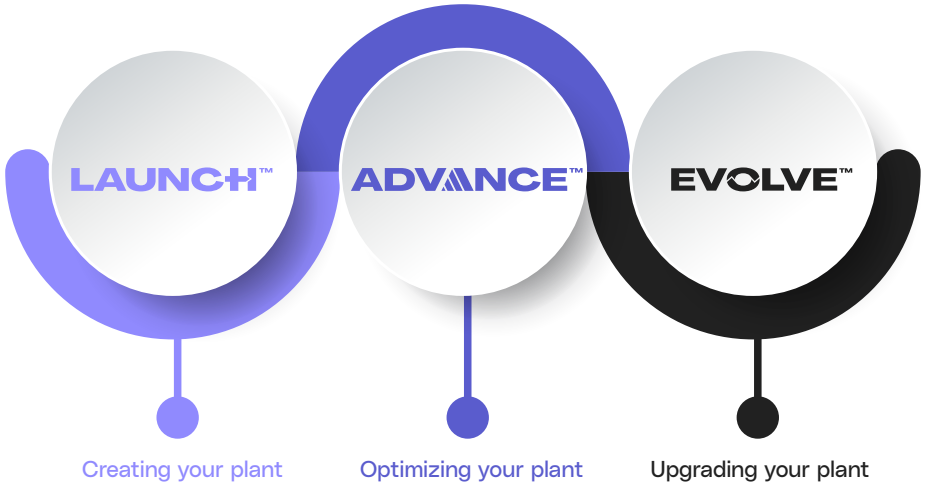
EVOLVE™

Upgrading your plant

Evolve your plant to the next level with revamp and debottlenecking:

Increase product capacity
Reduce emission output
Reduce energy consumption

We support the whole lifecycle of a urea plant.

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LAUNCH™
ADVANCE™
EVOLVE™

We will be your partner throughout the journey.

CREATING YOUR PLANT

Our LAUNCH series of technologies, products and services helps ensure your new urea plant is **designed and built** to optimal specs. You need to make important economic and technical decisions right from the start. We provide support in this essential exploratory phase, and will be your partner throughout the journey from **process design and project management to plant start-up.** When your plant is up and running you will produce urea of the highest quality. We provide various **melt synthesis** and **urea finishing solutions.**

LAUNCH™

- Project development
- Feasibility studies
- Technical & commercial services
- Process design proposal
- Basic design
- Proprietary equipment
- Detailed engineering
- Procurement
- Construction
- Pre-commissioning
- Training

1

MELT SYNTHESIS SOLUTIONS

Stamicarbon is well known for its technology solutions, not least the CO_2 stripping process invented in the 1960s. We work tirelessly to constantly innovate and improve our technologies. We are inspired to develop and refine melt technology solutions to meet your needs, in terms of capacity, CAPEX and OPEX.

Let's keep it simple

Our CO_2 stripping process designs simplify the overall design of your plant. These **compact designs require less equipment,** reducing your CAPEX. This ensures a less complex, more stable process, which also cuts maintenance costs.

We have designed and built more than 260 urea melt plants worldwide since the 1950s.

Designed to your specs
Our LAUNCH MELT™ series help you reduce your investment costs, raise plant efficiency, lower operating and maintenance costs, and minimize plant emissions. Depending on your capacity requirements, we offer three designs based on tried-and-true technology.

LAUNCH MELT™ Pool Condenser design

This widely used design provides optimal heat transfer, excellent process stability and high onstream time. It includes a high-pressure pool condenser and a relatively short vertical reactor. This is the most efficient technology option for a capacity between around 2500 and 6000 metric tons per day (MTPD).

LAUNCH MELT™ Pool Reactor design

Need a low-height plant with minimal piping and high-pressure equipment? This design combines the pool condenser and a vertical reactor in a single piece of equipment: the pool reactor. It's ideal for a capacity of around 2500 MTPD.

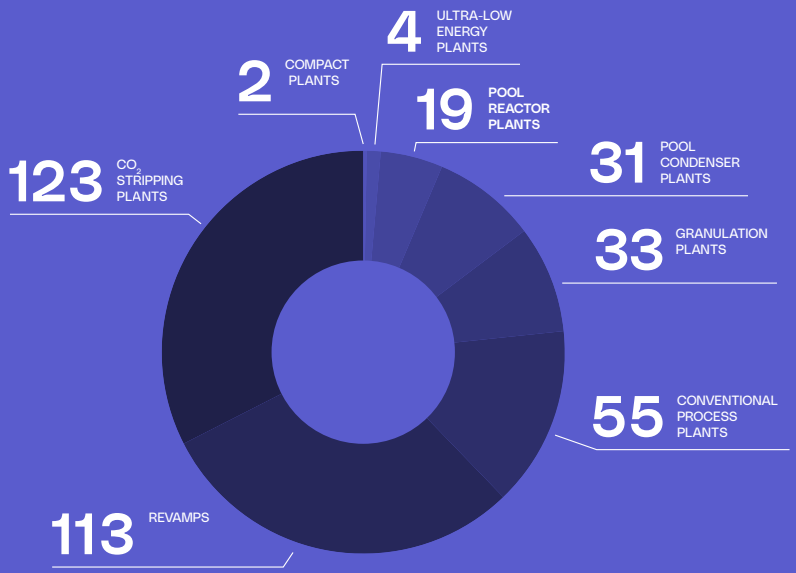
LAUNCH MELT™ Ultra-Low Energy design

This unique plant design lowers steam intake to an unprecedented level, creating the most energy-efficient plant on the market (HP steam consumption below 566 kg/ton). Ideal for locations where energy costs are relatively high. Our Ultra-Low Energy design requires lower investment in the urea section.

SYNTHESIS TECHNOLOGIES FACTS & FIGURES

OUR GLOBAL PRESENCE IN GRASSROOT UREA MELT PLANTS

MORE THAN **260** UREA MELT PLANTS WORLDWIDE



REDUCED STEAM CONSUMPTION PER KG/TON OF UREA

900 kg/ton
CO_2 stripping plants

1500 kg/ton
Conventional plants

-40%
REDUCTION IN STEAM CONSUMPTION

with future-proof
LAUNCH MELT™
Ultra-Low Energy Design

LAUNCH™

2

UREA FINISHING SOLUTIONS

Our finishing technologies reduce your CAPEX and maintenance costs.

We have various finishing solutions, depending on your needs. First and foremost, our **tried-and-true, state-of-the-art fluid-bed granulation technology** produces high-strength urea granules of the highest quality. We also have solutions for prills, pastilles and liquids.

Granulation design

Fact: There is a demand for large volumes of exportable granules with low formaldehyde content, produced with low environmental emissions and high on-stream time.

Our **tried-and-true granulation technology** meets this demand. Granules are the best end-product for exports and storage in large quantities, due to their **high crushing strength, low caking tendency and low dust formation**. Our fluid-bed granulation technology produces a superior product that complies with all mandatory quality standards. Formaldehyde use is minimized, a source of considerable savings.

The **film-spraying nozzles** ensure our design has the lowest dust production on the market, resulting in less fouling and long production times between cleaning cycles. That means **less downtime for clean-ups** and high on-stream time (more than 150 days). And our unique proprietary scrubbing design ensures this urea granulation solution has **the lowest plant emissions** on the market.

Other finishing solutions

Though granulation is the most popular finish, we also offer prilling and pastillation technologies. Prilling is the most cost-effective finishing method and is very well suited to local product distribution. Pastillation is economically viable from 120 MTPD and is ideally suited to specialty fertilizers and technical urea.

LAUNCH™

ADVANCE™

EVOLVE™

OPTIMIZING YOUR PLANT

By fully optimizing your urea plant, you extend its life, boost its output and raise its energy efficiency. Your urea plant will meet the highest safety standards and exceed all environmental regulations. Our ADVANCE series provides a range of **product and service options that take your plant performance to the next level.** We help you advance your plant operations in **five areas:**

1. **Inspections and plant maintenance**
2. **Improving product quality**
3. **Improving safety and reducing environmental impact**
4. **Optimizing plant output and operational control**
5. **Support and plant staff training**

ADVANCE™

- High-pressure equipment replacement
- Relining/repair
- Emission reductions
- Mechanical services
- Lifetime assessment
- Plant staff training
- Troubleshooting
- Process optimization tools
- Additives/coatings
- Plant inspections
- High-pressure piping/fittings/valves
- Process control equipment
- Welding training & supervision
- Spare parts

1

INSPECTIONS AND PLANT MAINTENANCE

From inspections, production improvements, monitoring and detection to tailored staff training and full lifecycle support. Our ADVANCE series optimizes the performance of your plant and helps you maintain a competitive edge throughout its operational life. You can even extend the life of your plant, improving the return on your investment. This is what we have to offer.

Leak detection

Our continuous leak monitoring service helps ensure new and existing lined high-pressure equipment operates safely and securely. You will detect any leak within an hour, wherever it occurs. You will be able to pinpoint its location and calculate its scale. Our leak detection system also detects and measures ammonia in the ppm range. Safety first!

Equipment relining

This cost-effective alternative to replacing high-pressure equipment helps you extend it's lifetime by resolving the issue of the thinning alloy protection and improving safety. You cut downtime and production losses with a minimal outlay. We offer both partial and complete relining. This is commonly done on urea reactors. In some cases, high-pressure strippers and high-pressure carbamate condensers can also be relined.



2

IMPROVING PRODUCT QUALITY

Our ADVANCE series helps you maintain and improve your product quality. That's key on your quest to keep meeting and exceeding your customer's expectations.

ADVANCE COAT™

This coating composition solution strengthens urea prill stability, significantly improving their handling and storage properties. You will be able to store (and ship) your prills for several months with minimal impact on product quality. It's also easier and cheaper to apply than urea formaldehyde. With no risk of foaming, this is a cost-effective, safe, and crop-friendly solution.

Prilling bucket

Our prilling bucket is specially designed to produce high-quality, uniform prills in a steady flow. It demands minimal cleaning during its long life. Your prilling bucket is tailormade to your prilling tower performance and product quality specs.

Improving the mechanical strength of your urea prills optimizes product quality and uniformity.

Prill impact strengthener

Improving the mechanical strength of your urea prills optimizes product quality and uniformity by seeding and reducing disintegration, dust formation and caking. We can do that for you.

UAN corrosion inhibitor

Corrosion can cause severe damage to equipment, pipes and tanks. The repair costs can skyrocket. Our UAN corrosion inhibitor shields carbon steel in various conditions, forming a stable, non-toxic, organic barrier that provides crucial long-term cathodic and anodic protection.

3

IMPROVING SAFETY AND REDUCING ENVIRONMENTAL IMPACT

There are various potential hazards in a urea plant. High-pressure equipment exposed to high temperatures and corrosive ammonium carbamate is most at risk. The smallest leak in the high-pressure synthesis section can lead to the release of toxic ammonia.

This is one of many reasons why appropriate HSE measures must be taken. Our ADVANCE HSE™ products and services help you improve the health, safety and environmental conditions in your plant.

We help you improve the health, safety and environmental conditions in your plant.

SAFETY

- **Lifetime assessment (LTA) for high pressure piping:** a risk-based inspection (RBI) to prevent catastrophic failures.
- **Urea design safety training:** a practical introduction to the most relevant risk scenarios to improve your hazard recognition and control skills.
- **Process safety plant review:** a spot check, comparing the plant design against internationally recognized engineering practices.
- **Radar level measurement:** an improved tried-and-true substitute for the commonly used radioactive level measurement. Safe and accurate.
- **Leak detection monitoring system:** a reliable solution to ensure safe operation of lined HP equipment in a urea plant.

- **Safurex® material:** originally a super-duplex stainless steel with superior corrosion resistance properties. Now a family of long-lasting solutions.
- **Plant inspection of HP vessels:** an in-situ check to identify and take action against existing and potential corrosion problems.
- **Ammonia storage tank inspection:** a thorough check of ammonia storage tanks, keeping shutdown to reasonable limits.
- **Safety services:** HAZOP support (change and project management), HSE management system assessment (OSHA/PSM) and major incident investigation.

ENVIRONMENT

- **Plant performance assessment:** a study of the safe working limits of each piece of critical process equipment and overall plant performance to maximize efficiency of safety, energy, effluents/ emissions, product quality, capacity.
- **Thermal treatment technology:** designed to incinerate the ammonia enriched off-gasses from the absorber, urea storage tank and ammonia water tank.

4

OPTIMIZING PLANT OUTPUT AND OPERATIONAL CONTROL

A plant assessment is absolutely essential to be able to identify opportunities to enhance plant performance. We assess and analyze your plant processes in depth and give advice about where any improvements could be made. We provide various consulting and monitoring services.

Plant assessment

Our plant assessment helps you evaluate opportunities to increase capacity, lower operating costs and reduce emissions.

The ideal way to find a sustainable solution to an operational bottleneck It also helps you analyze your plant status to identity ways to enhance performance

N/C meter

The N/C meter gives you precise control on your urea plant's N/C ratio to help you steer towards optimal performance. This ensures a more stable synthesis process and so more stable plant operations. You can also markedly increase your plant's capacity, while significantly lowering its steam and ammonia consumption.

Radar level measurement system

Our radar ensures safe, reliable and continuous level measurement in difficult process conditions. Suitable for new and existing high pressure equipment, it has no radioactive sources and requires no calibration.

NX STAMI™ DIGITAL

NX STAMI™ Digital:
Optimizing the future of plant operations

We understand that digitalization helps increase production efficiency, while reducing energy consumption, emissions and downtime. NX STAMI™ Digital is a range of digital solutions that turn real-time process data into meaningful information, providing your staff with insights in customizable dashboards, advanced automation and high-fidelity operator training simulators.
A personalized service that helps take your plant to new heights.

For more information check:

www.stamicarbon.com/digital

We assess and analyze your plant processes and give advice about where any improvements could be made.

5

SUPPORT AND PLANT STAFF TRAINING

We have developed various training programs to keep you and your staff up to speed. All trainings can be personalized to meet the needs of you and your staff. We provide operational and technical training and support, mechanical and maintenance training, and simulator training.

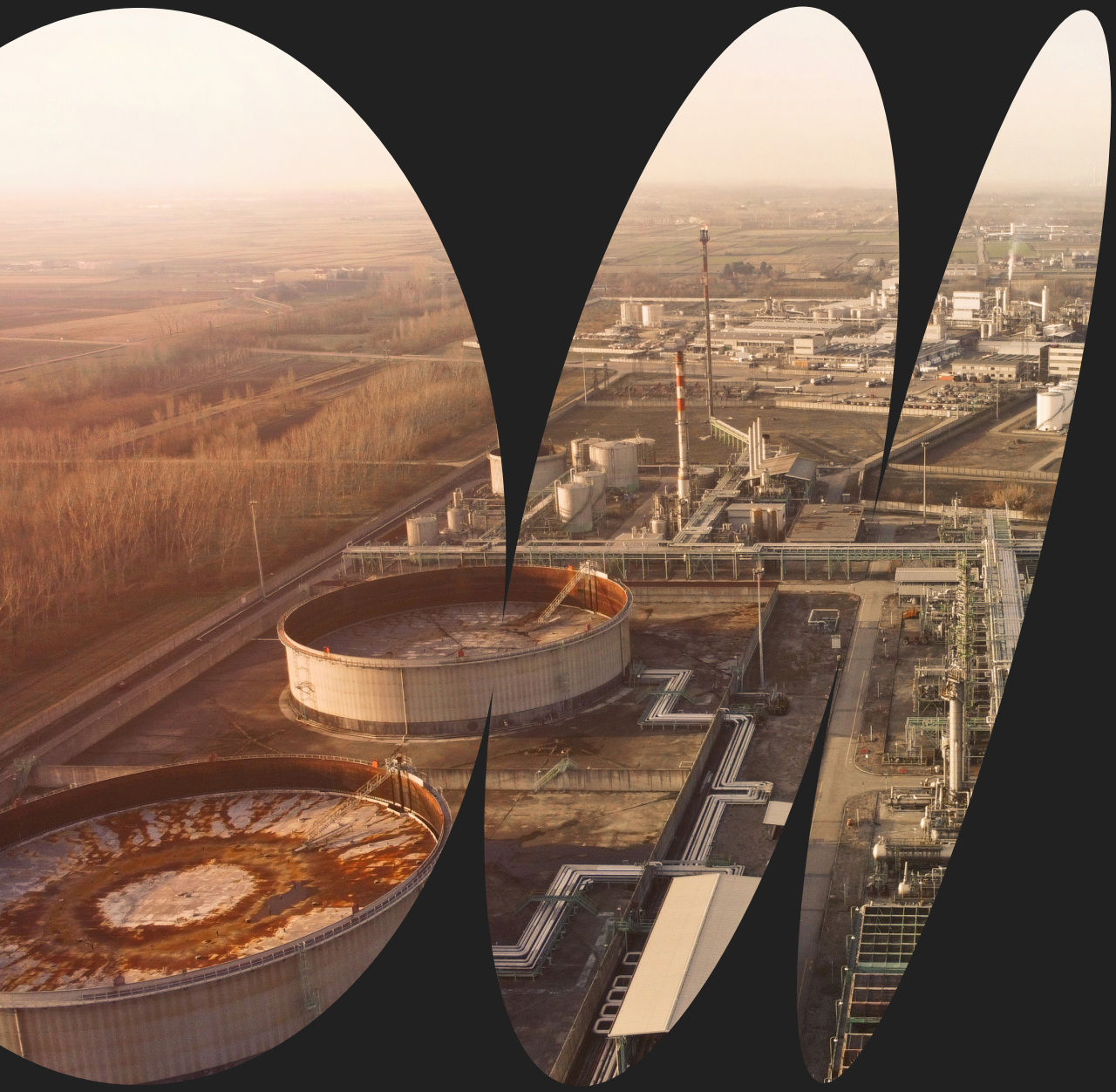
Urea process training

Process engineers learn about the whole urea process in this six-day course, which covers the basics (systems and reactions), urea process concepts, synthesis and high-pressure equipment, plant safety, revamp concepts and case studies. This training can be personalized to meet your specific needs.

Mechanical & maintenance training

This four-day program provides valuable insights that help you operate your urea plant at maximum efficiency. We improve the skills of your mechanical engineers, inspection engineers and maintenance managers (regardless of how much experience they have). Several case studies are discussed in detail.





LAUNCH™

ADVANCE™

EVOLVE™

UPGRADING YOUR OLDER PLANT

Our EVOLVE series provides the technology and solutions you need to upgrade your plant when new circumstances demand it. This ensures your aging plant remains compliant with amended legislation and stays competitive by adapting to changes in market conditions. To do so, EVOLVE includes such products and services as plant assessments, revamp studies, process design and debottlenecking.

Our EVOLVE series offers three main revamp solutions, each of which can be tailored to your specific needs.

1. **EVOLVE Capacity™**
   Boost output at your plant by anything from 10% to 100%
2. **EVOLVE Emission™**
   Reduce your emissions in step with international standards
3. **EVOLVE Energy™**
   Lower your steam use and optimize your feedstock consumption

EVOLVE™

- Pre-feasibility study
- Feasibility study
- Process design package
- Basic engineering package
- Proprietary equipment design & delivery
- Contractor guidance & control
- Commission assistance
- Plant assessment

1

EVOLVE CAPACITY™

Increasing your plant's output

Debottlenecking your plant is one way of increasing capacity. Potential gains depend on the availability of feedstocks, utilities and particular plant limitations. We have developed several **debottlenecking solutions** to meet your precise requirements. Hybrid solutions are also available.

Evolve capacity™ designs	Expected capacity increase* %
EVOLVE CAPACITY™ More-in More-out Design	10 - 30
EVOLVE CAPACITY™ Double Stripper Design	30 - 40
EVOLVE CAPACITY™ Add-On Mega Capacity Design	30 - 50
EVOLVE CAPACITY™ Pool Condenser/Reactor Design	50 - 100

*Based on nameplate capacity. The actual capacity gain depends on the original design margins of large-capital equipment.

What debottlenecking achieves:

- You can take full advantage of the plant's design margins
- You can boost urea production without extra people or infrastructure
- You can reduce your total costs of production
- You can give your plant a competitive edge

2

EVOLVE EMISSION™

Reducing your plant emissions

We have developed several technologies to improve the environmental aspects of urea plants in response to the imposition of ever-stricter emission standards. The finishing section is typically the main source of ammonia emissions in modern urea plant. We can **reduce your ammonia emissions to meet international standards,** regardless of whether your finishing section is geared to prilling or granulation.

How we reduce your emissions

The **MicroMist™Venturi Scrubber** is among our most effective emission control technologies. This highly-efficient scrubbing technology collects high submicron particulate matter (<1.0 m) and ammonia, producing concentrated blowdown streams. The **MicroMist™Venturi Scrubber** can collect urea dust emissions as low as 10mg/Nm^3. The **Jet Venturi Scrubber** is the best-in-class no-fan emission control process for prilling towers. This lightweight, dual-stage emission control system can be placed on top of the prilling tower. The scrubber takes advantage of the principles of a jet eductor to create a velocity differential between high-pressure atomized scrubbing droplets and fine urea particulate matter, while also activating polluted airflow using the Venturi effect.

Your benefits

- Easy installation due to modular design
- Meets stringent new emission regulations
- Tried-and-truehigh-performance submicron particulate
- Best available turndown ratio
- High-quality low-maintenance components
- Suitable for revamping or retrofitting existing scrubbers
- Proven track record

3

EVOLVE ENERGY™

Reducing steam use

Our continuous innovations in urea melt production technology and urea granulation technology lower energy consumption in your urea plant, reducing your construction costs and raising the efficiency of your production.

Lower energy consumption, lower construction costs, more efficient production.

WE SHARE OUR KNOWLEDGE WITH YOU

Stamicarbon is beside you every step of the way: from creating a new plant to optimizing and upgrading existing facilities in light of a sustainable and futureproof production.

CONCLUSION

Our solutions are built on 75 years of high-quality research and in-depth industry knowhow. We work closely with the entire value chain to improve and innovate our technologies. As the world's leading urea authority, we show our commitment to driving the long-term success of the industry by sharing our insights, solutions and knowledge.

Get more insights
Brochures, papers and other information published over many decades are available at www.stamicarbon.com.
We also share our knowledge at various conferences to keep you up to speed on the latest developments in urea.

Contact us
Interested in advancing your plant? We look forward to discussing your requirements and putting together a personalized proposal.

STAMICARBON

NX STAMI™ UREA
Technology design
Equipment supply
UAN & UAS technology
Services & Solutions

NX STAMI™ AMMONIA
Technology design
Equipment supply
Services & Solutions

NX STAMI™ NITRATES
Mono- & Dual-pressure Nitric Acid Technology
NO_x & N_2O abatement
Equipment supply
Services & Solutions

NX STAMI™ SPECIALTIES
NO_x reduction (DEF)
Controlled-release fertilizer
Coatings & additives

NX STAMI™ DIGITAL
Monitor Simulator

WE ARE STAMICARBON

WHAT CAN WE DO FOR YOU?

Stamicarbon, the nitrogen technology licensor of NEXTCHEM (MAIRE Group), designs and licenses fertilizer plant technologies, specializing in urea, green ammonia, and nitric acid. As part of NEXTCHEM, Stamicarbon leverages the capabilities and expertise of a world-leading engineering group. In total, Stamicarbon has licensed more than 260 urea plants and realized more than 100 revamping and optimization projects. Applying more than 75 years of knowledge and experience, Stamicarbon offers customers tailored solutions and services to maintain, improve and optimize plants in every stage of their life cycle, with a focus on sustainable fertilizer production. As pioneers with a higher purpose, Stamicarbon has a vision to help enable the world to feed itself and improve the quality of life. Stamicarbon is headquartered in Sittard, The Netherlands, and operates worldwide.

Questions?
Like to know how we can help you make the switch to sustainable, futureproof fertilizer production? We are here for you. Contact our experts at **www.stamicarbon.com.**

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