Enabling the world to feed itself
Licensing state-of-the-art urea plants
The United Nations expect the global population to grow to well over 8 billion over the next 3 decades. Arable land isn’t expanding at the same pace. Growing prosperity worldwide demands six times more fertilizer than required now for rice or grain. This all adds up to increased pressure on our agricultural resources.

Creating the right conditions for food security will mean improving agricultural production, increasing crop yields and farming in ever more sustainable ways. Of equal importance are the challenges we face to maintain air and soil quality for future generations. As pioneers with a higher purpose, we believe we can contribute to enabling the world to feed itself and improve the quality of life.

Over the coming pages, we’ll guide you through our market-leading urea expertise and full lifecycle support services. We hope to show you how we can make a contribution to improve yield, food security and ultimately, the quality of life for all.

As the world market leader in design, licensing and development of urea plants for the fertilizer industry, we apply our expertise, knowledge and experience in several areas; on fertilizers, emission reduction technologies, for improved air quality and all technologies for the integration of urea and adjacent processes.

Your reliable urea partner
Launched in 1947, we have been at the forefront of developments and innovations when it comes to urea. This has allowed us to gain pure knowledge that has in turn helped us to excel in our field. We feel it is our responsibility to ensure that your plants are safe, require a minimum number of equipment and run efficiently during a long lifespan. As the market leader for decades we are proud to be a founding partner of over 250 urea plants using our technologies around the world and having carried out over 90 revamp projects.

Stamicarbon’s headquarters are in Sittard, The Netherlands, with representative offices in Russia and China. Together with our excellent network of reputable partners we can provide all the technologies, equipment, products and related services you will need to contribute to improving the food supply to the world.
Stamicarbon is the innovation, leading technology provider and licensing company of Maire Tecnimont Group. The group is focused on plants for the hydrocarbon processing industries (Oil & Gas, Petrochemicals and Fertilizers), with competences in Power Generation and Infrastructure.

Maire Tecnimont Group has gained an unrivalled reputation, and an enviable track record in managing and completing successfully and safely numerous complex lump sum turnkey projects, all in different contexts worldwide.

Listed on the Milan Stock Exchange the Group is headquartered in Milan, but is present in over 30 countries. It controls 45 operating companies around the world and can count on about 4,300 employees.

To find out more about Maire Tecnimont and its activities, visit www.mairetecnimont.com
THE NEED OF FERTILIZERS
As crops grow they absorb nutrients directly from the soil. To maintain a rich and fertile growing environment, these nutrients need to be returned to the soil in order to prevent it from being depleted or crop production will stagnate or even cease.

UREA AND CROP NUTRITION
Since its discovery in 1773, urea is the most important nitrogen-based fertilizer in the world. Produced from natural gas and air (through derivatives ammonia and carbon dioxide), it’s a white crystalline organic compound that contains about 46% nitrogen. The vast majority of urea is used in the agricultural sector as a fertilizer to increase crop yield. Some 210 million tons of urea is produced each year, more than 80% of which is used to fertilize crops.

UREA MARKET
The global urea market is growing by more than 3% annually. This means that around seven new urea plants need to be built worldwide each year. Stamicarbon is capable of dealing with all challenges when developing and building a new plant. By delivering Stami Urea technologies, equipment, products and services for the design and development of state-of-the-art urea production facilities, we provide the best-in-class solution and will support you in every step of your journey.

CROP NUTRIENTS AND FERTILIZERS
Fertilizers provide the essential nutrients that crops need to grow, to be strong and to resist diseases. The nutrients are divided into two groups. Primary nutrients are Nitrogen (N), Phosphorus (P) and Potassium (K). These are often combined into an NPK blend. The secondary nutrients Sulphur (S), Calcium (Ca) and Magnesium (Mg) are needed in smaller amounts for crop growth.
With continuous support through the whole life cycle of your plant, regardless of the stage your plant is at, we offer you tailor-made technology solutions, products and/or services that match your needs. With three proven solutions, that suit a wide range of real world requirements, we address your questions and requests.

We call these our LAUNCH™, ADVANCE™ and EVOLVE™ series.

Your plant’s life cycle starts with launching the design, execute engineering, procurement and finally construction of your plant. After the LAUNCH™ phase of the plant, you enter into the next stage - ADVANCE™. Our products and services optimize the plant’s performance. Further we provide you with the means to upgrade your plant to EVOLVE™ to the next level.

Our engagement and commitment doesn’t stop after signing the contract and building your plant. We have developed an extensive technology, product and service portfolio for urea plants. We distinguish ourselves from the competition with our high quality standards and our Full Life Cycle philosophy.
LAUNCH™ SERIES: CREATING YOUR PLANT

The Stami Urea LAUNCH™ series is a group of technologies, products and services to ensure an effective design and optimal development of a new plant. From the moment you start to investigate the possibilities of building a urea plant, there are several economic and technical choices to be considered.

Stamicarbon will support you in this orientation phase and will be your partner throughout the whole journey of process design, project management and through to plant start-up.

Project Development
Whether you work with a government seeking to monetize natural gas resources or secure national fertilizer supply, or you are interested in diversifying your business activities, or you’re an investor, you’ll need to make two fundamental decisions – what to invest in and where. Fertilizers may be a lucrative option; for many an ammonia-urea plant in particular has shown a good return on investment; after all, urea is the world’s most used fertilizer.

At a very early stage, we like to be engaged in developing urea plant projects. Our activities can include researching project feasibility, exploring conceptual plant designs, evaluating investment cost, identifying equity/debt financing possibilities and assessing Return-On-Investment, determining and involving relevant parties in the value chain and supporting the permitting process to successfully start the urea plant construction project.

Feasibility studies
We support you with feasibility studies (including Front End Engineering and Design) from a market, logistical, regulatory, economical and technical perspective. These studies will result in better understanding of the technical and economic viability of the urea project which is important for the bankability and final investment decision of the urea project.

Technology and Commercial Proposal
Based on the plants feasibility study, we design a technology solution that best fits your needs. A commercial proposal will be generated containing the technology specifications, prices, guarantees and conditions of use.
SOLUTIONS FOR MELT SYNTHESIS

We are well known for our technology solutions, since inventing CO₂ stripping in the 1960s, we are dedicated to continuously improve and innovate our technologies. This has inspired us to develop the following technologies:

**LAUNCH™ Pool Reactor Design**

The UREA2000Plus® Pool Reactor is a low plant height design with a minimal amount of piping and high-pressure equipment and piping by integrating the pool condenser and a vertical reactor into one equipment piece: the pool reactor, resulting in great savings on capital cost. This design is perfectly suited for capacities typically up to about 2500 metric tons per day (mtpd).

**LAUNCH™ Pool Condenser Design**

Urea 2000Plus® Pool Condenser is a widely used design with optimal heat transfer, excellent process stability and high on-stream times. This design includes a high-pressure pool condenser combined with a relatively short vertical reactor and makes it the most efficient technology for capacities from about 2500 up to 6000 metric tons per day (mtpd).

**LAUNCH™ Mega Capacity Design**

An alternative for the large capacities up to 6000 mtpd is to apply the Mega Capacity Design from the EVOLVE™ series for a launch plant. In this design the additional stripping and condensing capacity is made available by installing an additional section in parallel to the urea synthesis section. This unique design allows for equipment to be designed for already proven capacities.

**LAUNCH™ Low Elevation Design**

Our Low Elevation Design has a different layout with the synthesis section at a lower elevation from the ground. The total plant height is brought down to only 22 meters, irrespective of the plant capacity. A low elevation of the synthesis section makes construction work easier and reduces investment cost.

**LAUNCH™ Low Opex Design**

With our LAUNCH™ Low Opex Design we minimize the steam intake to the urea plant to an unprecedented low level, resulting in the most energy efficient design available on the market.
Process design and basic engineering
Based on your technology choice we work on a comprehensive Process Design Package (PDP) and Basic Engineering Package (BEDP). This contains all engineering specifications and criteria to enable your Engineering, Procurement and Construction (EPC) contractor to make the detailed engineering and build your plant.

**OUR DESIGN PACKAGE INCLUDES:**
- Process basis of design
- Material balance, steam balance and cooling water balance
- Piping and instrumentation diagrams (PID’s)
- General design and material specifications
- Equipment data sheets
- Process flow diagrams
- Equipment & piping specifications
- Instrumentation & electrical specifications
- Design HSE and safety criteria
- Civil and structural design criteria
- Plot Plan
- Operating & Analysis Manual

Equipment supply
The design of proprietary high-end equipment needs to be best in class to secure best performance and a long operating lifetime. Stamicarbon’s equipment supply services are based on outstanding design and engineering expertise, combined with our in-depth knowledge of the fabrication process for which we only work with best in class vendors qualified by us. By maximized integration of our work process with the work process of the vendor, we can offer the shortest delivery times possible.
Pastillation
An enriching addition to the traditional finishing techniques is the Rotoformer® pastillation process designed by Sandvik Process Systems, which Stamicarbon can handily integrate with your urea plant. The pastilles can be produced at low investment costs, low operating costs and with a minimum of emissions. Moreover, as pastillation is already economically feasible at small capacities starting from 120 mtpd, it is ideally suited for producing specialty fertilizers and technical urea.

Urea Ammonium Nitrate (UAN)
An alternative way of fertilization is the liquid Urea Ammonium Nitrate (UAN). It has a low crystallization temperature, facilitating transport and storage, while application by spraying devices is easy and economical. UAN also allows for a more uniform distribution and portioning, also if mixing with other liquid fertilizers is desired. The Stamicarbon Partial-Recycle CO₂ Stripping Design is ideal for the manufacture of UAN solutions at low investment costs.

Diesel Exhaust Fluids (DEF) / AdBlue®
More stringent emission standards require vehicles to significantly reduce their NOx engine emissions. Therefore Diesel Exhaust Fluid (DEF) or AdBlue® is sprayed into the exhaust, reducing the NOx gases to nitrogen and oxygen, so clean air. As a licensor of urea technology, Stamicarbon was in the ideal position to develop a state-of-the-art solution taking into account all regulations and requirements. We have thoroughly investigated all the requirements, evaluated the options and have designed a cost effective solution for you, ensuring the highest quality product.

Technical Grade Urea for Melamine, Resins and Pharmaceutical applications
Melamine is used in the coating layer on tabletops, work surfaces and laminate floors, or as molding powder for kitchenware. The main feedstock for the production is urea. By using our unique knowledge of both urea and melamine, we implement the most effective solution for any type of coupling between a new or existing urea and a melamine plant.

Granulation
Granulation is regarded the best suited end-product for export purposes and storage in large quantities, because of its higher crushing strength and lower dust formation. Stamicarbon fluid bed granulation technology produces a superior product that complies with all required product quality standards. The key of our technology success is the minimum amount of formaldehyde, allowing for substantial savings. Our design has the world’s lowest dust production, ensuring less fouling and leading to long production times between the cleaning cycles. Furthermore, thanks to our unique proprietary scrubbing design, Stamicarbon urea granulation meets the lowest plant emissions available in the market.

Prilling
Prilling is the most cost-effective method of finishing and very suitable for local product distribution. Stamicarbon designs rotating prilling buckets, through which the liquid urea droplets are evenly distributed in the prilling tower, crystallizing to become prills when falling down in countercurrent with the prevailing air draft. Using an optional technique of seeding, the impact-strength can be enhanced even further, leading to better resistance to degradation during product handling.
Engineering, Procurement and Construction
We can support you with our network of licensed contractors that have a wealth of experience in implementing our state-of-the-art technology. As an independent licensor and partner in related services, we cooperate with many contractors around the globe. During the EPC phase, we can support in reviewing design documents and HAZOP activities.

Training
Personnel are key to successful operation. We conduct various customized training courses for operators and the maintenance crew on site or at Stamicarbon’s premises.

Plant pre-commissioning and Start-up
During the pre-commissioning stage our engineers complete a thorough check to ensure that everything has been built according to the Process & Instrumentation Design specifications (P&IDs). Amongst others we check the physical layout of the plant, accessibility, logics, water-based flushing and metering. Finally we support you in the first start-up of the urea plant up to full capacity and completion of the acceptance test.

At the stage your plant is up and running you are able to produce the highest quality urea.
ADVANCE™ SERIES: OPTIMIZING YOUR PLANT PERFORMANCE

A fully optimized urea plant has an extended life, increased output and optimized energy efficiency, highest safety standards and exceeds environmental regulations. Our ADVANCE™ series of Full Life Cycle services gives you a choice of product and service options for optimal plant performance.

Our ADVANCE™ series ensures the smooth and efficient operation of your plant in five areas:
1. Support and plant staff training
2. Optimize plant output
3. Improve product quality
4. Improve safety and environmental impact
5. Maintain the plant and equipment renewal
People are the key assets of your business, who require continuous training and education for optimal performance. Stamicarbon can offer exclusive on-site training tailored to the specific need of your plant staff, related to operations, technical, mechanical or maintenance. These trainings provide theoretical learning as well as plant simulator training or practical operation experience. Stamicarbon also offers regional training and tailor-made training at various levels of expertise and topics.

Typical topics for ADVANCE™ INSTRUCT:
• Philosophy of the process lay-out and fundamental theory of process design
• Operating modes: plant start-up, plant shut-down, block-in, draining, key plant-parameters
• Operating case discussions and trouble shooting
• Process control: critical instruments, logics, safety philosophy
• Urea process simulator
• Plant equipment inspection techniques
• Plant lifetime assessment philosophy
• Corrosion and welding phenomena in traditional steel materials
• Repair procedures and failure mechanisms
• SAFUREX® (mechanical properties, process advantages, and welding training)
• Mechanical aspects and maintenance experience
Plant or Equipment Assessment Study
Optimization of your urea plant is often focused on improving the stability and on-stream time of its operation, increasing plant load of your full process or specific equipment operation. It typically starts with a Plant Assessment Study (entailing both on-site and in-office activities) to determine its current condition and performance. Proprietary urea plant models are used to perform such assessment based on the actual plant data, allowing bottlenecks to be identified and the plant to be optimized by redesign and updated operator instructions.

Through optimization of your plant’s equipment and processes, you are ensured that your urea plant is not only operated in a sustainable manner, but also produces at maximum capacity with minimum energy consumption and with minimum emissions. To ensure your urea plant operates with maximum efficiency, we developed a range of plant operation services to improve performance, production and energy consumption.

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ADVANCE™ COAT

ADVANCE™ COAT is an innovative coating to increase the moisture-resistance, improve the handling and storage properties and replace the formaldehyde in prills.

We pride ourselves on working in partnership with our customers, specialized institutes and equipment suppliers to constantly improve the quality of the urea product. We offer several products and services, related to fluid bed granulation, prilling, Urea Ammonia Nitrate solution (UAN), Diesel Exhaust Fluid (DEF/AdBlue® technology and pastillation. An example of a recent product to improve product quality is our ADVANCE™ COAT.

ADVANCE™ COAT

ADVANCE™ COAT has superior performance.

Applying it to your prilling product:

• Enhances product storage by lower dust formation
• Improves product handling and shipping
• Replaces formaldehyde in your product

Prilled urea coated with ADVANCE™ COAT does not cause foaming in technical applications. It is also entirely safe for use as a cattle feed supplement.

There are various potential hazards in a urea plant. We offer assistance with HAZOP studies and support to keep the risks managed and under control. We prevent the potential accumulation of combustibles in your plant by a hydrogen removal unit. We monitor your plant integrity by continuous leak monitoring for lined high-pressure equipment. We advise on improvement of emissions by assessment of your current plant and reducing your emissions by improving your operation instructions, equipment design or introducing new technologies.

The ADVANCE™ PURIFY Thermal Treatment Technology

Reducing the impact on the environment is something that we all take seriously. The ADVANCE™ Thermal Treatment Technology is developed in close co-operation with the gas treatment experts of KT Kinetics Technology. The result is a urea melt plant with low ammonia emission without any need for an environmentally unfriendly and costly flare system.

Unique benefits of ADVANCE™ PURIFY Thermal Treatment Technology:

• Most environmentally friendly solution for off-gas treatment in the urea melt plant
• Lowest emissions available for urea melt plant with guaranteed ammonia (NH3) and NOx emission.
• Expected NH3 emission of < 1 ppm
• Complementary 20 bar steam generation
• Low CAPEX and OPEX
• Suitable for all urea plants of any process license
In order to ensure that your urea plant is always well maintained we offer a range of services in the ADVANCE™ INSPECT and ADVANCE™ DESIGN product ranges.

**ADVANCE™ INSPECT**
Our inspection services are specifically designed for high-pressure equipment, piping and life time assessment studies for your urea plant, as well as inspection services for ammonia plants and ammonia storage tanks. With unrivalled experience in the use of construction materials, the prevailing process conditions and their impact on degradation and corrosion, we are able to estimate the remaining lifetime of your existing high-pressure synthesis equipment.

**ADVANCE™ DESIGN**
Replacement of equipment in your plant gives you the unique opportunity to upgrade your equipment to the newest design insights and standards. Stamicarbon is able to design your equipment to the current process conditions and optimize your equipment performance accordingly.

Replacing existing equipment can be very critical, given design constraints and the time-sensitive nature of projects. Our ADVANCE™ DESIGN Equipment Supply combines our design and engineering competences with in-depth knowledge and experience of the fabrication process - all of which results in an extremely efficient delivery of high-quality equipment. Smoothest project execution - with a single point of contact - is secured through our own specialized project management team, coupled with close co-operation with our carefully selected and qualified equipment fabrication partners. The design and quality assurance / quality control during fabrication of the high-pressure synthesis equipment determines the reliability and availability of your urea plant.
Safurex® duplex stainless steel: resistant to corrosion

Developed together with our partner Sandvik Materials Technology, Safurex® is the standard for urea production. The use of Safurex® minimizes known active forms of corrosion that occur in the urea plant, thanks to its superior mechanical properties and improved processing. The result is that for high-pressure applications it outperforms any other viable stainless steel.

Safurex® offers numerous significant benefits, including:
- No risk for active corrosion
- No stress corrosion cracking
- No risk for condensation corrosion
- No risk for crevice corrosion
- Better mechanical properties, allowing for smaller wall thickness of equipment and piping
- Improved fatigue properties

This is only a small overview of the services and products in the ADVANCE™ series, which we provide to continuously advance your plant performance and product quality. For more services we are happy to talk with you to understand your needs, and how we can advance your plant's performance together.
The EVOLVE™ series ensures your plant is compliant with changes in legislation and stays competitive by adapting to changes in market conditions.

**Revamp and Debottlenecking Review**

Revamping your urea plant will help you take full advantage of your plant’s design margins, boosting urea production while minimizing investment in additional resources and infrastructure.

During the EVOLVE™ Revamp process, we monitor the engineering and after the construction stage, we will take an active role during the commissioning and start-up phase.

**Plant Assessment / Revamp Studies**

An EVOLVE™ project usually starts with an on-site plant assessment and debottlenecking study that determines the current performance levels of your plant and the opportunities for a capacity increase or a reduction of your plants emissions or energy consumption.

**Process Design**

Based on your individual requirements, we can tailor a unique process design, developed on our proven technology solutions that perfectly matches your needs and your plants specifications.

Our EVOLVE™ solutions come in 3 varieties: EVOLVE™ CAPACITY, EVOLVE™ EMISSION and EVOLVE™ ENERGY.
EVOLVE™ CAPACITY
Significantly increasing your plant output, from 10% up to 100%.

One of the revamp solutions to increase the capacity is debottlenecking your plant. The extent of debottlenecking of your urea plant will depend on the availability of feed stocks, utilities and particular plant limitations. We have developed several debottlenecking solutions that enable us to meet your exact requirements. Hybrid combinations of these solutions can be chosen as too.

Debottlenecking will enable you to:
- Take full advantage of the plant’s design margins
- Boost urea production with the same number of people and basic infrastructure
- Reduce total fixed and operating cost, lowering the price of the urea produced
- Improve the plant’s competitive advantage

EVOLVE™ EMISSION
Reducing emissions according to international standards

As communities and authorities enforce ever stricter emission standards, we have pro-actively developed several technologies to improve the Safety, Health and Environmental (SHE) aspects of all urea plants. In modern urea plants, the finishing section is usually the main source of ammonia emissions. Whether the finishing section of your urea plant uses prilling or granulation, we can reduce ammonia emissions to meet international standards.

EVOLVE™ ENERGY
Significantly lower steam utilization and optimal use of feed stock consumption.

Our continuous innovations in urea melt production technology and urea granulation technology reduce energy consumption in your urea plant, reduce construction costs and increase production efficiency.

EVOLVE™ OPTIMIZER
Plant managers are constantly under pressure to maximize profitability against the backdrop of global competition, tightening legislation on ecosphere load and fluctuating feed stock prices. Our efficiency and capacity optimizer helps to achieve such goal. It offers you the ultimate optimization for your plant, gives you insights on how to push your plant’s performance to its maximum capacity and increases margins simultaneously.

By optimizing the entire urea plant operation 24/7 all complex interactions in the process are taken into account. EVOLVE™ Optimizer will evolve your plant operators to plant operator supervisors, who need to guide the process through unpredicted upsets.

### EVOLVE™ CAPACITY Designs:

<table>
<thead>
<tr>
<th>Design</th>
<th>Expected capacity Increase*</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVOLVE™ More In More Out</td>
<td>10 - 30</td>
</tr>
<tr>
<td>EVOLVE™ Double Stripper Design</td>
<td>30 - 40</td>
</tr>
<tr>
<td>EVOLVE™ MP Add-On Mega Capacity Design</td>
<td>30 - 50</td>
</tr>
<tr>
<td>EVOLVE™ Pool Condenser / Reactor Design</td>
<td>50 - 100</td>
</tr>
</tbody>
</table>

*The reference for the given capacity increase is the nameplate capacity; actual achievable plant capacity increase depends on the original design margins of the large capital equipment.

EVOLVE™ OPTIMIZER is Stamicarbon’s innovative solution to:
- Increase urea production load
- Stabilize plant operations
- Reduce energy consumption

EVOLVE™ Optimizer is Stamicarbon’s innovative solution to:
- Increase urea production load
- Stabilize plant operations
- Reduce energy consumption
Our solutions are based on years of high-quality research and in-depth knowledge of the industry, gained in licensing more than 250 urea plants and revamping more than 90 plants worldwide. We work closely with the entire value chain to improve our current technologies and develop new ones. As the world’s leading urea authority we are committed to the long-term success of this industry and that means sharing our insight, solutions and knowledge.

On our website www.Stamicarbon.com you will also find our Knowledge Center. Here you can access all our brochures and papers that have been published over the years. Our knowledge is shared during conferences and webinars on specific topics that allow you to keep up to date with the latest developments in urea.

**Experience it yourself**
Whether you want to launch, advance or evolve your plant we would like to invite you to have a conversation with us. As this brochure is only a highlight of our knowledge and capabilities, we would like to assess your requirements and develop a customized proposal that is tailored to your exact needs.
We are proud to share our success stories with you and a complete list of references is available online and in a separate reference list. Here are just a few examples of our lately completed projects:

**Design:** LAUNCH™ Urea 2000Plus®
**Pool condenser**

**Customer:** Turkmenhimiya State Concern
**Location:** Mary City, Turkmenistan
**Capacity:** 1925 mtpd
**Contractor:** Kawasaki Plant Systems, Japan
**In operation since:** 2014

**Design:** LAUNCH™ Urea 2000Plus®
**Pool condenser**

**Customer:** Inner Mongolia Bodashidi Chemical Company
**Location:** Wushen, China
**Capacity:** 2860 mtpd
**Contractor:** Wuhan Engineering China
**In operation since:** 2014

**Design:** LAUNCH™ Urea 2000Plus®
**Pool Reactor**

**Customer:** Phosagro – Cherepovetsky Azot JSC
**Location:** Cherepovets, Russia
**Capacity:** 1500 mtpd
**Contractor:** Chemoprojekt, Czech Republic
**In operation since:** 2012