Dedicated to bringing energy all around via innovative cable solutions







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Power projects



Land and submarine

The transmission of power is at the heart of the energy value chain, from the point of which it's generated right through to distribution to the end user, whether this be a private home or a large industrial complex. As energy generation is progressively switching to the utilisation of more sustainable sources, transmission grids are required to adapt accordingly by integrating remote, renewable power plants and connecting them with alternative transmission networks.

Security of electricity supply at a competitive cost is fundamental to current and future grid development strategies around the globe, and plans to increase the interconnectivity between countries and regions, or to replace or upgrade the existing grid infrastructure, include land and submarine cables.

One response to both current and future challenges in grid performance and supply reliability is to use underground cable networks, which have become increasingly viable alternatives to traditional overhead lines thanks to advances in technology and reductions in overall system costs. Borealis has developed the Borlink[™] technology platform, a complete global package of power cable compounds and expertise with applications for high voltage (HV), extra high voltage (EHV) and high voltage direct current (HVDC) energy supplies. Based on our enhanced base resin technology Supercure, Borlink[™] insulation compounds are unique and innovative materials offering superior cleanliness essential for reliable high performance.

For our valued customers, these compounds provide:

- Increased scorch safety during cable extrusion, lowering risk of insulation defects
- Long cable production runs
- Reduced degassing time burden, optimising production with 10–20% shorter production cycles and the subsequent reduction of associated capital costs



Extra High Voltage (EHV)

As the leading industry supplier with a long proven track record in close co-operation with the global cable industry, Borealis and Borouge have always been at the forefront of cross-linked polyethylene (XLPE) development. Superclean XLPE insulation was first introduced in 1973 for the initial XLPE 84 kV submarine cable and has advanced to EHV cables up to 550 kV.

Committed to working in partnership with customers to target developments that directly respond to their needs, Borealis has established a dedicated technology for the production and supply of compounds that enables the manufacture of EHV cables which can withstand higher field stresses. By establishing the Borlink[™] technology, Borealis and Borouge have elevated their total network of support to a new level by helping to facilitate the combining of different grids and energy sources, both regionally and globally.

Together with the correct cable design and manufacturing care, clean high quality XLPE compounds can hugely improve cable system reliability. Contaminants reduce the insulation performance and increase the risk of system failure, meaning the use of clean high quality XLPE compounds is essential to avoid reduction in insulation performance and critical system failure. Borlink™ EHV XLPE insulation compounds are produced in a closed loop system and delivered in Borlink™ octabins filled under clean room conditions to preserve the cleanliness of the compound.

Even at the highest of electrical stresses, a smooth interface between insulation and shielding increases the potential of maintaining an uninterrupted power supply. Our Borlink[™] EHV Supersmooth semi-conductive compound has been designed to provide the smooth even surfaces required to eliminate surface pips, reduce electrical stresses and minimise the risk of power failure. Together with the best outer protective Borstar[®] or Casico[™] jacket, we can offer our customers the most reliable system solution for EHV cables with confidence.

Reference projects – Proven Borlink™ EHV track record

Project name	Voltage (kV)	Cable length (km)	Entered in service
Copenhagen 1 & 2, Denmark	400	108	1997 & 1999
Berlin 1 & 2, Germany	400	63	1998 & 2000
Dachaoshan, China	525	7	2001
Taiwan	345	64	2003
Seoul, South Korea	345	66	2003
London Project, UK	400	60	2004
Madrid Airport, Spain	400	90	2004
Rotterdam, The Netherlands	400	12	2005
Bureyskaya, Russia	500	2,5	2005
Vienna, Austria	380	32	2006
Milan, Italy	400	13	2006
Istanbul, Turkey	380	27,9	2008
Porce III, Columbia	500	5,4	2010
Beddington Tunnel, UK	400	30	2011
BEC submarine connection, NJ-NY, US	345	34,4	2012
Little Belt, Denmark	420	48	2013
Beijing, China	500	40	2014
Dardanelles I, Turkey	380	24	2015
London Tunnel, UK	400	32	2015
Kollsnes – Mongstad, Norway	420	32	2016
Chino Hills, US	500	24	2016
Zhoushan, China	500	18,5	2018



Production characteristics	Borlink™ semiconductive screen	Borlink™ insulation	Jacket
Normal viscosity	LE0500	LS4201EHV	Borstar® HE6062 / HE6063 Casico™
High viscosity (Low sag)	LE0500	LE4244EHV	Flame retardant FR6082 LE0563 – semiconductive jacket



High Voltage Alternating Current (HVAC)

Having satisfied the rising demand in transmission projects with proven technology in HV cables for some time, Borealis and Borouge have an impressive track record. More than 300,000 kilometres of cabling has been installed worldwide using Borealis compounds, a distance that spans over three times the circumference of the earth, and we are on our way to making another global lap with Borlink[™] XLPE based on Supercure technology.

Our Borlink[™] LS4201S is ahead in its field. With a significantly improved scorch safety that lowers the risk of insulation defects and an inherently reduced degassing time,

manufacturers can look to gain optimised production cycles and running times which are especially beneficial in highdemanding submarine cable applications. To guarantee their absolute cleanliness, all Borlink[™] Supercure LS4201S insulations are produced and packed on specifically designed lines.

Our advanced equipment and quality management systems leave nothing to chance, meaning that utility providers can trust cabling with Borlink[™] insulation based on Supercure technology to deliver long-term reliability and improved overall safety.

Examples from offshore wind export cable projects

Project name	Voltage (kV)	Transmission capacity (MW)
Riffgat, Germany	150	108
Dudgeon East, UK	132	402
Northwind, Belgium	245	216
Racebank, UK	220	573
Horns Rev 3, Denmark	220	406
Anholt, Denmark	220	400
Beatrice, UK	220	558
Three Gorges Fafeng, China	220	400
Putlan Nanri, China	220	400
Longyuan Dafeng, China	220	200

Product	Borlink™ semiconductive screen	Borlink™ insulαtion	Jacket
High productivity XLPE (Supercure based compound)	LE0592S	LS4201S	Borstar® HE6062 / HE6063 Casico™
High viscosity XLPE (Low sag)	LE0592S	LE4244S	Flame retardant FR6082 LE0563 – semiconductive jacket

High Voltage Direct Current (HVDC)

Polymeric DC insulation materials were first established in the 1990s in parallel with the expansion of voltage source converter technology, with Borealis as pioneering material developer. Borealis' 20 years of unrivalled commercial experience now stretches beyond 6000 km of in-service HVDC cables.

This first generation of extrudable polymeric XLPE HVDC solution is based on Borlink™ LE4253DC XLPE and LE0550DC semicon, designed to provide minimum space charge accumulation. It's Supersmooth and provides both conductor and insulation shielding, even with even surfaces that reduce electrical stresses.

Next generation HVDC supporting extruded HVDC transmission at EHV level

HVDC power transmission technology supports long distance electricity transport without significant losses, making it very efficient and environment-friendly. The industry trend is clearly moving towards an increased need for higher transmission capacity at EHV levels. With this in mind, Borealis recently introduced the next generation HVDC insulation compound, Borlink[™] LS4258DCE, which, along with the accompanying HDVC semicon Borlink[™] LE0550DC, enables the use of extruded cable technology at EHV and transmission levels in instances where paper cables are traditionally used. Based on the proprietary Borlink[™] technology, Borlink[™] LS4258DCE is an unfilled XLPE compound based on enhanced base resin Supercure technology and is produced at Borealis' state-of-the-art high pressure production facilities in Stenungsund, Sweden, a plant recently supported by major investments.

World record performance at 640 kV

Type test and pre-qualification testing of extruded cable systems according to the Cigré recommendation TB496 has now been successfully achieved at world record 640 kV, based on a cable produced with Borlink[™] LS4258DCE as insulation and Borlink[™] LE0550DC for semi-conductive layers. This key performance indicator is made possible by the unique character of the insulation compound, which combines high levels of both chemical and physical cleanliness to achieve the required results. Our customers can benefit from the fact that this unrivalled product is furthermore designed to enable a significant reduction of degassing burden and improved scorch performance. Borlink[™] LS4258DCE key properties:

- High levels of both chemical and physical cleanliness
- Significantly reduced degassing burden
- Superior electrical performance in terms of DC conductivity, required for extra high DC voltage applications
- Excellent scorch performance

Our recommended solutions

Product application	Borlink [™] semiconductive screen	Borlink™ insulαtion	Jacket
High Voltage Direct Current (≤320 kV)	LE0550DC	LS4258DCS	Borstar® HE6062 / HE6063 Casico™
Extra High Voltage Direct Current (>320 kV)	LE0550DC	LS4258DCE	Flame retardant FR6082 LE0563 – semiconductive jacket

Reference projects – More than 20 years of extruded HVDC track record

Project name	Power (MW)	Voltage (kV)	Cable length (km)	In service
Gotland, Sweden	60	80	140	1998
Tjoerborg, Denmark	8	9	9	2000
Direct link, Australia	180	84	390	2000
Cross Sound, USA	330	150	84	2002
Murraylink, Australia	200	150	360	2002
Troll A 1 & 2, Norway	80	60	68	2004
Estlink, Finland-Estonia	350	150	105	2006
Trans-Bay, USA	400	200	85	2010
Borwin 1, Germany	400	150	400	2010
East West IC, Ireland-UK	500	200	512	2014
Zhoushian, China	1160	200	294	2014
Nan´Ao Islands, China	100	160	37	2014
Borwin 2, Germany	800	300	400	2015
Helwin 1, Germany	576	250	260	2015
INELFE, France-Spain	1000	320	264	2015
Sylwin 1, Germany	864	320	410	2015
Helwin 2, Germany	690	320	260	2015
Dolwin 1, Germany	800	320	330	2015
Troll A 3 & 4, Norway	100	60	280	2015
ÅLlink, Finland	100	80	316	2015
Nordbalt, Sweden-Lituania	700	300	906	2016
Dolwin 2, Germany	916	320	160	2016
Caithness-Moray, Scotland	1200	320	226	2019

Power transmission





High Voltage (HV)

The world of energy is changing together with society's raising concern of global warming. While energy consumption in cities is increasing, driven by the growing number of electric vehicles and electric heating solutions, more renewable energy sources such as local wind and solar farms are being built to produce energy in a more sustainable way. Reliable power transmission lines are required to transport this energy to distribution networks, and as overhead lines can be unsightly, power transmission is consequently moving underground.

At Borealis, partnership goes beyond delivering products, and we are dedicated to finding new ways to support our customers. Our Borlink™ LS4201H insulation compound for HV cables is based on Supercure technology and has a significantly improved scorch safety that lowers the risk of defects in cables. Improved scorch performance allows longer production runs and, in combination with the built-in reduced degassing time, cable manufacturers can expect an optimised production cycle.

By ensuring a sustainable production process, encompassing efficient decision making paired with effective solution finding, Borealis is committed to enabling successful project execution, whilst assuring the utmost reliability to our clients. HV cables with Borlink[™] insulation based on Supercure technology enable reliable power transmission with long-term reliability in a sustainable way.

Our recommended solutions for T&D

Land Application	≤ 36 kV	≤ 69 kV (Um ≤ 72,5 kV)	≤ 161 kV (Um ≤ 170 kV)	≤ 230 kV (Um ≤ 245 kV)
XLPE (MFR 2)	LS4201R (dry design), LH4201R (wet design)		LS4201H	LS4201S
XLPE (MFR 0,8)	LE42	244R	LE4244S	LE4244S
Semicon	LE0592, LE0595 (bonded) LE0520 (strippable – up to 46 kV)		LE0592 LE0595	LE0592S LE8280
	< 20 191			
Submarine	< 36 kV		< 69 kV	< 230 kV
Submarine Application	≤ 36 kV	(≤ 69 kV Um ≤ 72,5 kV)	≤ 230 kV (Um ≤ 245 kV)
Submarine Application XLPE (MFR 2)	≤ 36 kV LH42	(201R (with bonded screer	≤ 69 kV Um ≤ 72,5 kV) n only)	≤ 230 kV (Um ≤ 245 kV) LS4201S
Submarine Application XLPE (MFR 2) XLPE (MFR 0,8)	<mark>≤ 36 kV</mark> LH42 (for dry	201R (with bonded screer LE4244R r design cable constructi	≤ 69 kV Um ≤ 72,5 kV) n only) on only)	≤ 230 kV (Um ≤ 245 kV) LS4201S LE4244S

Power distribution



Medium Voltage (MV)

High productivity Borlink[™] XLPE insulation enables increased productivity at low cost, whilst sustainably improving production flexibility.

Urbanisation remains one of the prime global factors in rising energy demands, meaning the ongoing development of power distribution networks is essential. The growing population in big cities leads to a rising number of vehicles on the road, which continues to raise ecological concern. With this in mind, it can be assumed that the number of plug-in hybrid and fully electric vehicles will substantially grow over the coming years, increasing the need for fast and smart charging stations, which will require investment into researching and developing new power distribution infrastructures.

Keeping up with the needs of power distributors is a huge challenge for medium voltage (MV) cable makers as they need to be able to raise production levels in a

cost-effective way without compromising cable quality or long-term reliability, whilst continuing to meet sustainability requirements. With Borlink[™] high productivity XLPE from Borealis, cable makers now hold the key to increasing their production, whilst lowering their costs.

Our Borlink[™] copolymer offering allows 10–20% faster cable manufacturing than classic homopolymer XLPE, whilst delivering an outstanding wet ageing electrical performance that meets the most stringent of market requirements. In addition to this, our Borlink[™] homopolymer offering based on Supercure technology means cable makers can potentially extend production runs by more than 30%, thanks to its superb scorch-retardant properties.

As a result, more kilometres of cable can be produced in the same period with the same equipment, meaning manufacturers are likely to secure more business in the marketplace.



Product	Borlink™ conductor screen	Borlink™ insulation	Borlink™ insulαtion screen	Jacket
Increased CV line speed	LE0592	LH4201R	LE0592	Borstar® HE6062 / HE6063 ME6052 / ME6053 LE8707 / LE8706
Wider process window – Longer production runs	LE0592	LS4201R	LE0592 LE0520	LE0563 – semiconductive jacket

Low Voltage (LV)

The strain on existing electricity distribution networks is expected to increase as the number of electric vehicles and solar panels rises. In order to avoid electricity breakdowns and manage a secure supply during peak consumption hours, low voltage (LV) cables insulated with XLPE can be used to ensure uninterrupted delivery for decades.

With unique features, XLPE insulated cables provide advantages for the whole electricity distribution value chain. Utilities can expect to benefit from capacity increases of up to 10% more than if using PVC, and there are less electricity losses as well as better corrosion protection, particularly in wet environments. There's a benefit to both consumers and the ecosystem; with 30% less insulation there are reduced material needs, and the absence of chlorine and halogens means less hazardous materials are present. In addition to this, installation can take place at any time of the year as XLPE can withstand much colder temperatures.

Using XLPE, Borealis has developed an unrivalled environment-friendly product that specifically addresses cable manufacturers' needs. Our moisture cured Visico™/Ambicat™ solution provides a cost-effective and quality-consistent product that supports our customers' bottom-line by reducing waste, increasing productivity and reducing overall costs.

Insulation	Jacket
Visico™ Base materials: LE4423 (Natural) LE4427 (Black) LE4421 (Natural) ME4425 (MD Natural)	Borstar® HE6062 (Black) HE6063 (Natural) LE8707 (Black) LE8706 (Natural)
Ambicat™ Catalyst: LE4476 (Natural) LE4472 (Black)	Casico™ – Flame retardant FR6082 (Black) FR6083 (Natural) FR4803 (Natural)





Industries and buildings



Visico[™]/Ambicat[™]

The demand for LV cabling is high, but manufacturers are facing stricter requirements and severe competition, meaning cost-efficiency and high-value solutions are crucial in order to remain in business. With such high stakes, no other moisture-cured XLPE solution gives higher productivity and output than our Visico™/Ambicat™.

Because our Visico[™] based material is reactor-made, the quality is high and extremely consistent. Scorch performance is unrivalled, allowing production runs of up to one month without the need to clean the extruder. Ambicat[™], the catalyst used in combination with Visico[™], uses an environment-friendly organic acid as its active substance as opposed to harmful tin-organic additives. Moreover, it offers significantly faster cross-linking which facilitates the curing of the insulation at room temperature or in ambient conditions without the use of a water baths or saunas.

Visico[™]/ Casico[™]

At Borealis, when it comes to making cables for energy distribution and communication, functionality, safety and considering the ecosystem are our primary concerns. To meet the increasing demands of environmental and safety regulations, we now offer a unique halogen-free flame-retardant system in the form of Casico[™] jackets. Not only are they around 20% lighter than alternative plastics, this product also exhibits reduced heat release and smoke generation, meaning no corrosive gas emissions are produced, which in turn reduces secondary fire damage to equipment and installations. Furthermore, cross-linked Visico[™]/Casico[™] compounds offer a downsizing potential of up to 40% and are a cost-effective insulation compared to PVC. They also boast superior dielectric properties.

Always looking to support our customers' needs, as well as considering the safety element we've been mindful of production performance, and Low Smoke Zero Halogen (LSZH) cables can be produced on most PVC and PE extrusion equipment. Using less material with a lower weight than alternative plastics, our LSZH system also respects the environment without compromising on performance.

Insulation	Jacket
Visico™ LE4423	Casico™ FR4803
Ambicat™ LE4476 (Natural)	



Communications

Taking the lead in technical insulation and jacketing

In today's wired world, network providers require cables that can carry reliable, quality transmissions at increasingly higher frequencies to offer broader bandwidths. Borealis compounds help meet those requirements for fibre optic, data, copper multipair and coaxial cables.

Data cables

HE4883 is our ADCA-free compound for physical foamed insulation of data cables. Offering the advantages of a full compound, it enables stable processing at high line speed and has a fine and uniform cell structure with increased crushability. In addition to this, longer production runs can be achieved due to an anti plate-out nucleating agent system. HE4872 is our recommended solid insulation with improved copper adhesion to reduce cross talk due to its improved conductor adhesion. An added advantage of this product for our customers is that it can also be used as conductor and outer skin, as can our ME6032.

Copper multipair

Borealis offers a broad product range for copper multipair cabling, from solid and chemical foamed insulations to polyethylene jackets. These include our ME1254 an ADCA-free compound for chemical foaming.

COAX

We provide a complete range of gas injection insulation for coaxial cables. Our HE1106 is a fully formulated gas injection insulation for 75 ohm cables, whilst HE4883 is our customer's first choice for mini coax cables due to ease of use and consistent processability matched with excellent dielectric properties. Next to these fully formulated compounds, Borealis also offers a two component solution for 50 ohm cables.

Fibre Optics

Borealis combines a broad range of fibre optic jacketing with unique high-end products based on our Borstar[®] technology. For linear low, medium and high density we have both a black and a UV-protected natural version, all combining great stress cracking performance with easy processability. Committed to offering our customers and partners the best quality, innovative products, at our high-end, the extra low shrink grades HE6067, HE6068 and our latest innovation, the black laser printable Borstar[®] HE6069, are all unique in the market. In addition, Borealis can also offer the anti-tracking jacketing Borstar[®] HE6081 as well as the PP1121, used for polyproylene loose and central tube constructions.

	Insulation	Jacket
Data cables	HE1344, HE4872, HE4883, ME6032, HE1355	
Copper multipair	HE1344, HE1345, HE3366, ME1244, ME6032, HE1355	Borstar® HE6062 / HE6063 ME6052 / ME6053
COAX	LE6006 HE1106 (75 ohmn) LE1120-HE1123 (50 ohm)	LE8707 / LE8706 LE6022
Fibre Optics	PP 1121 Buffer and central tube	Borstar® HE6067, HE6068, HE6069, ME6052, ME6053 LE8706, LE8707
	Borstar® HE6081	

Cable jacketing

Power transmission and distribution

Our Borstar[®] technology makes it possible to combine excellent stress cracking results with great mechanical performance and easy processability. Our most popular offerings include the black and natural HDPE Borstar[®] HE6062 and HE6063 and the linear low density Borstar[®] LE8707.

Communications

For the communication segment, Borealis offers Borstar[®] Bimodal grades such as LE8707 and HE6062, both of which display great mechanical performance and easy processability. For improved flexibility we also have unimodal LDPE LE6022 and LLDPE LE6027.

Fibre Optics

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Flame retardant







Automotive

Global automotive manufacturers continually strive to improve vehicle performance while at the same time look to fulfil increasingly complex environmental and safety-related requirements, all of which vary according to their global location. Automotive wiring must be cost-efficient, deliver high temperature and wear resistance, and offer great flexibility, whilst meeting all the relevant technical specifications.

At Borealis we offer a broad range of peroxide and irradiation XLPE flame retardant compounds which have been specifically developed to provide ideal primary wiring solutions in automobiles. We're always looking to improve and expand our offerings in the interest of our customers, and are introducing the new ISO 6722, a halogen-free, thermoplastic solution based on polypropylene which enables simple extrusion without the need for crosslinking.

Infrastructure

Power cables installed in sensitive areas such as tunnels often need flame-retardant jackets to protect from fire, which should also exhibit mechanical properties to prevent potential damage including cracks. With this in mind, Borealis have created specially designed Casico™ products FR6082 and FR6083 for installation in tough environments.

Solar

With a growing demand for solar installation globally, the need for high productivity solar cables is increasing. Our newly developed Visico[™] FR4451 / LE4439 system is specifically designed to meet the challenging requirements for photovoltaic cables according to EN 50618. On top of meeting general specifications, this compound enables easy processing and great storage stability.

Buildings

Whether used in residential, commercial or industrial buildings, flame-retardant materials are subject to increasingly stringent regulations. Manufacturers are required to supply building products that exhibit low flame propagation and smoke effluent generation and fulfil all applicable safety specifications, whilst needing to be easily manufactured.

At Borealis we offer flame-retardant solutions which meet industry standards. Our proprietary Casico[™] compounds exhibit reduced heat release and smoke generation, whilst producing no corrosive gas emissions, and our lower density compounds permit downsizing, thus contributing to environmental sustainability: less material is required whilst maintaining superior system performance.

As LV cables across various applications are frequently used at high temperatures, there's an increasing demand for cross-linkable flame retardant materials. Our newly developed Visico™ FR compounds are designed to meet challenging requirements in mechanical and electrical properties, are easy to process, and have long storage stability.

Summary

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Borealis and Borouge are the world's leading providers of innovative and sustainable high quality plastics solutions for the wire and cable industry, enabling electricity to be safely and efficiently transmitted and distributed all over the globe.

We are actively committed to investing in our customers' continued success, and our partnerships go beyond delivering products whilst we strive to constantly consider the needs and requirements of our users in order to provide the best possible service.

- Leading innovator providing reliable and comprehensive solutions for our customers to differentiate their products.
- Global presence enabling customers to meet the fast growing demands in the markets.
- Long-term reliable partner with solid industry knowledge and proven technology, offering consistent and high-quality products.
- Investing for the future not only supported by our forward-thinking on innovation but also by our commitment to asset investments.

Borealis and Borouge are the world's leading providers of innovative, value creating plastics solutions for the wire and cable industry. Our solutions are customer-driven and designed to satisfy the industry's continuously evolving demands for higher technical performance. Consequently, they can be found in the most challenging EHV and HV cable applications, as well as MV and LV energy transmission and distribution cables, building wires, and communications cables.

In answer to the need for production, installation and cable-system lifetime enhancements, we create the innovation links that secure world-class, step-change solutions and benefit the whole wire and cable value chain. Through the introduction of unique polymer technologies, which include Borlink[™], Visico[™] / Ambicat[™], Borstar[®], and Casico[™], we continue to pioneer the development of

advanced insulation and jacketing systems for both energy and communication cables.

Built on more than 50 years experience, Borealis and Borouge have a well-established track record in serving customers' needs with the consistently high quality products expected of global leaders. We are committed to extending that leadership position and our role as reliable partners for the long-term – a commitment not only supported by our forward thinking in innovative solutions, but also confirmed by ongoing investments for our customers' continued success.

Through ongoing research and development, investment in the future and a dedicated team with solid industry knowledge, we aim to remain fully responsive to our customers' needs throughout the world.

Bringing energy all around

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About Borealis Borealis is a leading provider of innovative solutions in the fields of polyolefins, base chemicals and fertilizers. With its head office in Vienna, Austria, the company currently has more than 6,900 employees and operates in over 120 countries Borealis generated EUR 8.1 billion in sales revenue and a net profit of EUR 872 million in 2019. Mubadala, through its halding company, owns 64% of the company, with the remaining 36% belonging to Austria-based OMV, an integrated, international oi and gas company. Borealis provides services and products to customers globally, in collaboration with Borouge, a joint venture with the Abu Dhabi National Oil Company (ADNOC) and with Baystar[™], a joint venture with Total in Texas, USA.

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