

Innovation & Product Stewardship

Promote the development of sustainable products while pursuing innovation



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The purpose of Nippon Paint Group is enriching our living world through the power of Science + Imagination. It describes our commitment to creating innovations that bring benefits to our society, by using our technical strengths and intellectual assets, including intellectual property, organizational capability, and technology networks, across Nippon Paint Group. One recent example is that, since the outbreak of COVID-19 pandemic in 2020, the Group has significantly increased investment in anti-viral technology, and developed a range of paint products to address this social challenge.

Our technology mission is to drive and sustain growth and market share in Japan and globally through striving to be a leading technology organization for coatings and its adjacent markets. There are three pillars in our innovation strategy: 1) build adaptive organization; 2) develop core enabling technology competency, and 3) grow into adjacent and emerging markets. It is the implementation of our Group vision for Maximizing Shareholder Value from a technology perspective. We believe that our technology organization's culture of being customer centric, socially responsible and collaborative is the key driver to success.

Importantly, the technology collaboration and intellectual property sharing among our partner companies around the globe is under the principle of Asset Assembler model, which Nippon Paint Group strategically employs to manage the business of partner companies. The technology teams of partner companies possess high autonomy to effectively address the needs from their respective markets and customers. On the other hand, in order to drive technology sharing and capability leveraging among partner companies, the Global Technology Council (GTC) was established, to promote technology exchange platforms and cross-PC projects. We have built up adaptive ways to enhance global technology collaborations to enhance added value of intellectual property. The technology teams in decorative paints have formed the global technical community to share best practices and leverage research capability in joint technology development projects, helping address the needs from local consumers in each respective country. Our major automotive customers are global accounts, and our technical staff in automotive coatings around the globe were unified and became ONE team in 2021 under Nippon Paint Automotive Coatings (NPAC).

Innovation for a sustainable future



In today's society, problems that are difficult to solve with past methods are becoming more and more apparent. We will strengthen our innovation output with active utilization of partnerships.

Significance of R&D activities in our paint and paint related businesses in utilizing and adding value to intellectual property

Worldwide there are 3,887 technical staff working in Nippon Paint Group, with 1,171 in Japan. They are our strong innovation power and core competitiveness for achieving sustainable business growth in the marketplace. Our technical staff are working in 50 R&D and technical centers to serve our domestic and global customers and consumers, including our major R&D centers in Tokyo and Osaka in Japan, Shanghai in China, Singapore, Melbourne in Australia, Los Angeles and Cleveland in the US, and France in Europe. In 2021, the total technology related expense in Nippon Paint Group is above 24.3 bn yen. In 2021, Nippon Paint Group has filed 200 new patents, and by end 2021 owned 1,000 granted patent rights.

Nippon Paint Group has classified its core technologies related to paint and coatings and manages its intellectual property portfolio in 10 categories, which are polymer chemistry, color science, formulation, curing technology, dispersion technology, application technology, process technology, rheology, weathering and corrosion, and measurement science. Subject matter experts are working in core R&D teams in the R&D centers, and collaborating with scientists from the global network of technical centers to support product development across the group.

Nippon Paint Group possesses a broad open innovation network with universities and academic research institutions worldwide. In 2020, the strategic research partnership with The University of Tokyo was initiated, with the University of Tokyo & Nippon Paint joint laboratory established. The partnership aims to create innovative coating technologies in three fields, infectious disease risk reduction,

social cost and environment burden control, and contribution to smart society. In Singapore, NIPSEA Group has been collaborating with the research institutes of A*STAR (Agency for Science, Technology and Research) for decades. Recently, NIPSEA Group has strategically joined hands with A*STAR to develop disruptive technologies in the fields of smart surface enabling autonomous driving, and applying artificial intelligence in coating research.

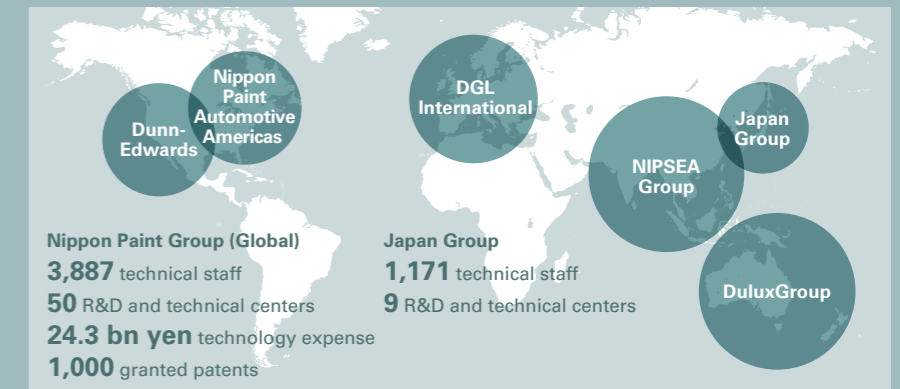
Innovation initiatives and programs

New Product Sales Index (NPSI)

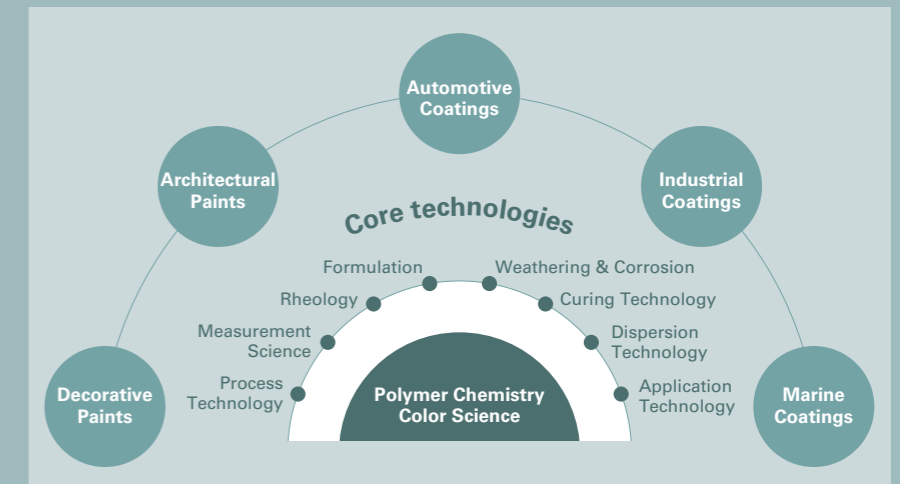
New Product Sales Index (NPSI) is one of the indicators for measuring technology output. In Nippon Paint, we have established well-designed NPSI system with tools, to track the sales revenues generated from new products commercialized in the past three years. New products are categorized ranging from products upgrade by incremental improvement, to new-to-market products by disruptive innovation. NPSI is achieved with joint efforts of technical teams with business and supply chain operation teams, where strong collaboration brings together our commitment to Maximization of Shareholder Value.

NIPSEA Group started to implement NPSI in 2018. In 2021, Japan Group and NIPSEA Group together have achieved NPSI of 21.1%, and launched 18,000 new products in the same year.

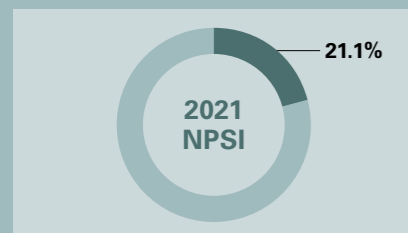
R&D organization



Core technologies



2021 New Product Sales Index (NPSI) of Japan Group and NIPSEA Group (%)



Sustainability of our products

In Nippon Paint, we regard that sustainable features are essential factors for our products to benefit human society and thus achieve long-term business success. We define the product sustainable advantages in the principle of product life cycle and according to the framework of The United Nation's Sustainable Development Goals (UN SDGs). It is a systematic approach, covering the three main stages of product life cycle, eg.

1. product production,
2. products in application, and
3. products in service.

Furthermore, in each stage, the advantages over the mainstream products in the market are assessed by translating UN SDGs to the attributes of paint and coating products. In the stage of product production, manufacturing efficiency, raw materials, logistic and packaging, are the key aspects for assessment. In the stage of products in application, the advantages are helping customers and consumers when using the products, by reducing energy and material consumptions, chemical emissions, and chemical hazards. In the stage of products in service, the products are assessed in product service life, used in clean technologies, contribution to health and well-beings, as well as end-of-life treatment.

Under those sustainability principles, Sustainability Scoreboard for new product assessment has been developed and started implementation in NPSI systems of partner companies, Japan and China Group. In 2021, of new product sales of Japan Group and China Group together, 38% were contributed from newly developed sustainable advantaged products.

Meanwhile, Green Design Review has been developed and started implementation into R&D project management systems of Japan Group and NIPSEA. From our project portfolios of Japan Group and NIPSEA, 40% of R&D projects are in the focus areas of creating sustainable benefits according to the Green Design Review principles.

Management of chemical substances

In 2021, Japan Group launched the chemical substance management system named "Green 30," in order to minimize the impact on environment and human health. The system is developed to manage chemical substances not only from Japanese chemical regulations, but also chemical substances of global concern from international treaties such as REACH regulations. We classify the chemical risks in three categories according to the laws and regulations in the countries where our business operates: prohibited, restricted for new introduction, and avoided for new introduction. The system started in operation in Japan in 2021, and the practice is being introduced to our partner companies outside Japan.

Alkylphenol ethoxylates (APEO) are surfactants and include a subcategory of nonylphenol ethoxylates (NPEO/NPE). These types of nonylphenols (NPs) are being regulated by the EPA and REACH. Nippon Paint has been steadily phasing out APEO-containing surfactants. In 2021, we eliminated the use of the nonylphenol compounds in our products in Europe. Dunn-Edwards continues to phase out APEO-containing surfactants through product improvement and ensures that no new APEO-containing raw materials are allowed in the newly developed products.

In addition, we have been substituting the UV absorbers that are being considered as persistent organic pollutants (POPs). Our next plan is to completely phase them out in all products for Europe by the end of 2023.

In DuluxGroup, managing the risks associated with hazardous chemicals used in the formulation of the products is an important priority for our businesses. We have developed a management approach to ensure that substances with potential for long term health or environmental effects (chemicals of concern) are identified, with their risk evaluated. Improvement actions, such as formulation changes or improved packaging and labelling, are put in place to reduce or eliminate the risk of harm. Chemicals of concern are identified from information on supplier safety data sheets, regulatory lists such as the European "Substances of Very High Concern" and stakeholder sustainability program listings (e.g. Living Building Challenge Red List).

Whenever a new ingredient is proposed for introduction, it is reviewed against the Chemicals of Concern criteria and existing

listing. If identified as a chemical of concern, a risk assessment is undertaken to determine if the chemical can be safely used in the specific product and by the intended end-user or if additional controls or an alternative formulation is needed.

Scientific knowledge, regulations and community concern related to chemicals are constantly evolving. To keep our knowledge up to date, DuluxGroup has also established a process for monitoring and reviewing stakeholder and regulatory reviews of chemical classification so that emerging concerns can be picked up and acted on pro-actively.

The effectiveness of our program is measured by tracking the usage of priority chemicals of concern (in kilograms per \$000 sales) and the proportion of chemicals that have had a risk management plan developed. Since 2018, DuluxGroup has had a 17% reduction in the usage of priority chemicals of concern, despite the addition of some new substances to our chemicals of concern listing. Some examples of our chemicals of concern initiatives in 2021 include:

- Dulux Protective Coatings: Congard product is now Cobalt and Meko free.
- Dulux Protective Coatings: Formulation of a new toluene-free epoxy primer, Durepon 66.
- Dulux Porter's: Reformulation away from crystalline silica in its product range.

Case studies
 Innovation cases

While we are facing major challenges nowadays, such as uncertainty in economic growth, high industry dynamics, and increasingly stringent environment regulations, we firmly believe there are also huge opportunities for innovative products that offer sustainability advantages to tackle those challenges, especially contributing to a carbon neutral society and in line with UN SDGs. Thus, our innovation directions are toward environmental friendly, energy efficient and economically viable paint products.

Innovations in anti-viral paints

In the Japan market, Nippon Paint launched PROTECTON® brand in September 2020, named after the function to "PROTECT" people's lives from threats of viruses and bacteria + to turn the function "ON" to the surfaces of all things. Since then, we have combined all of Nippon Paint Group's paints, coatings and surface treatment technologies to offer a lineup of products for industrial, DIY and household use.

In February 2022, Nippon Paint (NPTU) released "PROTECTON Interior Wall VK Coat" and "PROTECTON Floor VK Clear" and Nippon Paint Automotive Coatings released "PROTECTON Car Interior VK Coat." Three of these new products have been added to PROTECTON brand. In addition to the "Interior Wall series" for interior walls, "Floor VK Clear," a water-based clear paint for floors, is expected to be effective when droplets containing viruses adhere to floor surfaces. "Car Interior VK Coat" is expected to have sustained anti-viral function with excellent appearance due to its uniform application property to the car interior and its high adhesion to the substrate.

In addition, our group and the University of Tokyo have jointly conducted research activities on coatings technologies with anti-viral and anti-bacterial functions to reduce the risk of infection. This is one of the joint research themes under the

industry-academia co-creation agreement concluded in May, 2020.

It is a joint effort across the globe in Nippon Paint Group to fight against viruses. Nippon Paint China launched "ClearShield" antimicrobial technology, which means "Virus Clear, Health Shield," in October 2021. The innovative coating products and film using this technology have color change resistance and good anti-viral performance in accordance with Chinese anti-viral coating code. In January 2021, Nippon Paint China released antimicrobial Kid's Paint, which can reduce the bacteria (S. Aureus, E. Coli, etc.) and virus (H3N2, EV71, Human-corona virus 229E, etc) pollution on the coating surface, with added functions of HCHO abatement, low VOC and low odor performance.

In Nippon Paint Malaysia, "VirusGuard" was developed with silver ion technology to persistently inhibit the growth of viruses and bacteria on the coated surface, decreasing the spread of contagious illnesses including, Hand, Foot and Mouth Disease (HFMD), H1N1 as well as COVID-19. Nippon Paint Singapore has also launched "VirusGuard" and "VirusGuard+" coating products, based on the silver and cuprous technologies, respectively.

Dulux UltraAir®

In response to broader societal concern about indoor air quality, DuluxGroup Australia has launched the UltraAir® interior wall paint range. The products have ultra low odor and ultra low chemical emissions. Going beyond low VOC, UltraAir® has achieved GreenGuard Gold certification. This is a third party certification that tests for over 10,000 chemicals and volatile organic compounds (VOC) and demonstrates that UltraAir® helps reduce indoor air pollution. These new advanced formulations have also achieved Global GreenTag GreenRate Level A and Platinum Health certification and can contribute to the achievement of green

building project certifications such as WELL and Green Star. UltraAir® has a verified Environmental Product Declaration (EPD) that quantifies the environmental footprint of the product. The availability of EPDs along with GreenTag certification is well regarded in the commercial sector in Australia while reducing odor and fumes is important to both trade and household consumers, meaning the UltraAir® product has significant appeal across all market sectors.

Chromium (Cr) free primer for construction industry

With the recent issuance of different regulations regarding pollution control for VOCs and heavy metals, environmental protection has been gaining more focus in the construction industry. Nippon Paint has developed chromium (Cr) free primer for coil coatings, which has now become an important element in industrial applications. This environmentally friendly coating can be widely applied to large areas of metal for decoration and protection.

Occupational Safety and Health Administration (OSHA) studies have determined that hexavalent chromium poses significant medical risks to users. Not only is it considered a potential lung carcinogen, but it can also cause nose, throat and lung irritation, with prolonged exposure resulting in ulcers and perforation of the septum. The new Cr free coil coating primer can help to eliminate the medical risks to users and meet the regulatory requirements. This new technology also exhibits excellent corrosion resistance and mechanical properties compared to those obtained in industrial oil-based primers.

The new Cr free primer products have been introduced to our customers in China as the largest coil coating market. Nippon Paint has completely phased out Cr containing primer products for coil coatings in China.



Innovations in anti-viral paints

Dulux UltraAir®