Set forth below are the aggregate amounts, as of December 31, 2017, of our future contractual financing and licensing obligations under our existing debt and other contractual arrangements:

	Payments Due by Period				
Contractual Obligations	Total	Less than 1 year	1-3 years	3-5 years	More than 5 years
			(in millions of Won)		
Long-Term Debt, including current portion	₩5,607,357	₩1,453,167	₩3,077,603	₩883,734	₩192,853
Fixed License Payment	85,420	28,473	56,947	—	—
Long-Term Other Payables	2	—	2	—	—
Total	₩5,692,779	₩1,478,040	₩3,134,552	₩883,734	₩192,853
Estimates of interest payment based on contractual interest rates effective as of December 31, 2017	₩ 289,529	₩ 131,480	₩ 123,596	₩ 31,602	₩ 2,851

In addition to fixed license payments listed above that we are obligated to make under certain technology license agreements, we also have continuing obligations to make cash royalty payments under our technology license agreements, the amount of which are generally determined based on a percentage of sales of our display products.

Expenses relating to our license fees and royalty payments under existing license agreements were ₩88 billion in 2015, ₩94 billion in 2016 and ₩107 billion (US$100 million) in 2017, representing 5.7% of our research and development related expenditures in 2015, 6.6% in 2016 and 5.6% in 2017. We expect to make additional license fee payments as we enter into new technology license agreements from time to time with third parties.

Taxation

In 2017, the statutory corporate income tax rate applicable to us was 11.0% (including local income surtax) for the first ₩200 million of our taxable income, 22.0% (including local income surtax) for our taxable income between ₩200 million and ₩20 billion and 24.2% (including local income surtax) for our taxable income in excess of ₩20 billion. The effective tax rate applicable to us may further increase in 2018 pursuant to the Korean government's announcement in December 2017 to raise the corporate income tax rate applicable to companies whose taxable income exceeds ₩300 billion from 22% to 25%, excluding local municipal taxes. However, such announcement by the Korean government did not change the minimum corporate income tax rate applicable to us.

Tax Credits

We are entitled to a number of tax credits relating to certain investments in technology and human resources development. For example, under the Special Tax Treatment Control Law, we are entitled to a tax credit of up to 4% for our capital investments made outside certain areas of Seoul on or before December 31, 2017, provided that the number of our employees does not decrease compared to the previous year.

Tax credits not utilized in the fiscal year during which the relevant investment was made may be carried forward over the next five years in the case of capital investments and five years in the case of investments relating to technology and human resources development. As of December 31, 2017, we had available deferred tax assets related to these credits of ₩269 billion (US$252 million), which may be utilized against future income tax liabilities through 2022. In addition, we also had unused tax credit carryforwards of ₩150 billion (US$141 million) as of December 31, 2017 for which no deferred tax asset was recognized.

Item 5.C. ***Research and Development, Patents and Licenses, etc.***

Research and Development

The display panel industry is subject to rapid technological changes. We believe that effective research and development is essential to maintaining our position as one of the industry's leading technology innovators. Our research and development related expenditures amounted to ₩1,547 billion in 2015, ₩1,423 billion in 2016 and ₩1,912 billion (US$1,791 million) in 2017, representing 5.4% of our revenue in 2015, 5.4% in 2016 and 6.9% in 2017.

To meet the demands of the future trends, we have formulated a long-term research and development strategy aimed at enhancing the process, device and design aspects of the existing products and diversifying the use of display panels as new opportunities arise with the development of communication systems and information technology. The following are examples of products and technologies that have been developed through our research and development activities in recent years:

- In 2015, we developed the world's first Ultra HD OLED television panels, including 65-inch and 77-inch panels that feature High Dynamic Range functionality with perfect black and improved luminance. In addition, we unveiled a 55-inch "wallpaper" OLED television panel which was slim and light enough to attach to the wall simply by using magnets or wires. We were able to achieve this width using an innovative production method whereby the electric circuits are installed in a separate process. In the commercial space, we developed the world's first 55-inch double-sided OLED panel for commercial use, which shows different images on each side while achieving a width of only 5.3 mm, as well as a 139-inch Vertical Tiling OLED display that is made of eight 65-inch OLED panels connected together in a double-sided S-curved pattern. We also successfully commenced mass production of in-TOUCH panels for notebook computers. With respect to smartphones, we developed the world's first 5.5-inch Quad HD in-TOUCH panel and the world's first 5.7-inch free-form Quad HD panel.

- In 2016, we developed wallpaper-thin 65-inch OLED television panel with a thickness of 2.57mm. In addition, we unveiled a 65-inch Ultra HD OLED television panel with speakers integrated into the display, and we developed a 65-inch ultra-slim OLED television panel that applies High Dynamic Range technology to achieve 800 nit peak luminance and improved display quality. We also developed a 55-inch Full HD transparent OLED television panel, with a transparency level of 40%. In the case of LCD panels, we developed the world's first 86-inch ultra-stretch format LCD television panel with a 58:9 screen aspect ratio. With respect to monitors, we successfully developed the world's first in-TOUCH monitor panel as well as the world's largest, at the time, 21:9 screen aspect ratio IPS curved monitor utilizing Ultra Wide Quad HD technology. With respect to smartphones, we introduced our "Always-On Display" technology which enables the display of 24-hour information such as date, day, time, and battery status even when the screen is off, and reduces unnecessary power waste. We also unveiled the world's first 12.3-inch transparent OLED display and 6.13-inch mirror display for Glass OLED.

- In 2017, we unveiled the world's first 77-inch flexible and transparent Ultra HD OLED display panel with a transparency level of 40% and a radius curvature of 80mm. We also developed the world's first Crystal Sound OLED television product, which achieves a new platform concept through the development of OLED panel products with integrated speakers. In addition, we developed the world's first 88-inch ultra-stretch LCD panel for commercial use. In the case of monitors, we produced the world's first 31.5 inch Ultra HD LCD panel with "8K" resolution. With respect to smartphones, we released a 5.7-inch Quad HD-plus full vision LCD display and a 6-inch Quad HD plastic OLED panel for smartphone products. With respect to automotive displays, we successfully developed and commenced production of in-TOUCH LCD panels.

As the product life cycle of display panels using certain of the existing TFT-LCD technology is approaching maturity, we plan to further focus on OLED and other newer display technologies, while also exploring new growth opportunities in the application of display panels, such as in tablet computers, smartphones, smartwatches, public displays and automotive displays.

In order to maintain our position as one of the industry's technology leaders, we believe it is important not only to increase direct spending on research and development, but also to manage our research and development capability effectively in order to successfully implement our long-term strategy. In connection with our efforts to enhance our research and development capability with respect to next-generation display technologies, we opened the R&D Center in Paju, Korea in April 2012. In addition, we have further expanded our research and development resources by allocating some of our research and development personnel to the newly-opened LG Science Park, which is located in western Seoul and commenced its operations in December 2017. LG Science Park accommodates researchers from various LG Group-affiliated companies with expertise in a broad range of disciplines, including electronics, chemistry, nanotechnology, display, fabrication, life sciences and new materials, to focus on developing and testing innovative new technologies.

We complement our in-house research and development capability with collaborations with universities and other third parties. For example, we provide project-based funding to both domestic and overseas universities as a means to recruit promising engineering students and to research and develop new technologies. In April 2016, we entered into an agreement with Pohang University of Science and Technology, or POSTECH, to establish the LGD-POSTECH Cooperation Center within the university's Research Institute of Electrical Circuit, Algorithm and Advanced Materials to conduct research into display panel technologies, including OLED technology. We also enter into joint research and development agreements from time to time with third parties for the development of technologies in specific fields. In addition, we belong to several display industry consortia, and we receive annual government funding to support our research and development efforts. As of December 31, 2017, we employed over 4,800 engineers, researchers, designers, technicians and support personnel in connection with our research and development activities.

While we primarily rely on our own capacity for the development of new technologies in the display panel design and manufacturing process, we rely on third parties for certain key technologies to enhance our technology leadership, as further described in "—Intellectual Property" below.

Intellectual Property

Overview

Our business has benefited from our patent portfolio, which includes patents for display technologies, manufacturing processes, products and applications related to the production of TFT-LCD and OLED panels. We hold a large number of patents in Korea and in other countries, including in the United States, China, Japan, Germany, France, Great Britain, Taiwan, India and Vietnam. These patents will expire at various dates upon the expiration of their respective terms ranging from 2018 to 2036. In March 2014, we formed Unified Innovative Technology, LLC in the United States, a limited liability company solely owned by us for the purpose of patent portfolio management.

As part of our ongoing efforts to prevent infringements on our intellectual property rights and to keep abreast of critical technology developments by our competitors, we closely monitor patent applications in Korea and various other countries in which we sold our products. We intend to continue to file patent applications, where appropriate, to protect our proprietary technologies. We also enter into confidentiality agreements with each of our employees and consultants upon the commencement of an employment or consulting relationship. These agreements generally provide that all inventions, ideas, discoveries, improvements and copyrightable material made or conceived by the individual arising out of the employment or consulting relationship and all confidential information developed or made known to the individual during the term of the relationship are our exclusive property. In addition, we have increased our efforts to safeguard our propriety information by engaging in in-house information protection awareness activities with our employees.

License Agreements

We enter into license or cross-license agreements from time to time with third parties with respect to various device and process technologies to complement our in-house research and development. We engage in regular discussions with third parties to identify potential areas for additional licensing of key technologies.

Expenses relating to our license fees and royalty payments under existing license agreements were ₩88 billion in 2015, ₩94 billion in 2016 and ₩107 billion (US$100 million) in 2017, representing 5.7%, 6.6% and 5.6% of our research and development related expenditures in 2015, 2016 and 2017, respectively. We recognized royalty income in the amount of ₩19 billion in 2015, ₩14 billion in 2016 and ₩17 billion (US$16 million) in 2017. The following are examples of license agreements we have entered into:

- We have a license agreement with each of Columbia University, Penn State University, Honeywell International, Honeywell Intellectual Properties, Plasma Physics Corporation and Fergason Patent Properties. Each license agreement provides for a non-exclusive license under certain patents relating to TFT-LCD technologies.
- We entered into a license agreement with Semiconductor Energy Laboratory which provides for a non-exclusive license under certain patents relating to TFT-LCD and AMOLED technologies.
- We entered into a cross-license agreement with each of Hitachi, HannStar and Hydis for a non-exclusive license under certain patents relating to display technologies.
- We entered into separate cross-license agreements with each of NEC and AU Optronics in connection with the settlement of certain patent infringement lawsuits. Under the agreements, each party grants the other party a license under certain patents relating to TFT-LCD technologies.
- We are licensed to use certain patents for our TFT-LCD products pursuant to a cross-license agreement between Philips Electronics and Toshiba Corporation.

In addition to the above, we have also entered into license or cross-license agreements with other third parties in the course of our business operations in connection with certain patents, which such third parties own or control.

As well as licensing key technologies from third parties, we aim to benefit from our own patents and other intellectual property rights by granting licenses to third parties from time to time in return for royalty payments. We have also entered into certain patent purchase and license agreements with third parties, where we receive a portion of the license payments.