



WWF

REPORT

KR

2017

The background of the cover is a photograph of two large white wind turbines with red-tipped blades. They are situated on a rocky, grassy cliff overlooking a body of water. The sky is a clear, pale blue.

# REPUBLIC OF KOREA 2050 ENERGY STRATEGY FOR A SUSTAINABLE FUTURE

Korea Energy Vision 2050

Summary

## WWF (World Wide Fund for Nature)

WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption. WWF-Korea was launched in 2014, after 10 years of conservation in Korea, based in Seoul.

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As part of the WWF's Climate & Energy Programme, the report was published by domestic and international researchers in the relevant sectors jointly with WWF to propose Korea's 2050 energy vision and roadmap.

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# CONTEXT

## MORE ACTION IS NEEDED AND POSSIBLE - TO SHIFT TOWARDS A CLEAN ENERGY FUTURE

The Republic of Korea urgently needs a bold new energy vision – with a clear roadmap to get there. The case for change is increasingly clear from both a national and global perspective:

- Firstly, energy security is a vital issue for any country. With over 95% of energy currently imported, a clean energy future can enable a much greater level of energy independence and stability;
- Secondly, the health and well-being benefits of a clean and safe energy transition are significant. The Republic of Korea is at risk of becoming one of the world's most polluted countries with issues such as air pollution becoming increasingly serious, and social concerns about the safety of nuclear power are increasing.
- Thirdly, Korea is facing the challenge to modernize the economy in a sustainable way, to create new jobs and growth, while exploring new ways to encourage more innovation and investment. A clean energy future can be a tremendous engine of employment and growth;
- Finally, climate change is one of the greatest challenges which we face and must be tackled in order to sustain a living planet. Without significant reductions in greenhouse gas emissions (GHG), humanity will rapidly head to a global warming of up to 4-6°C which would have disastrous consequences.

With this in mind, WWF-Korea has partnered with several leading experts to develop this study, which evaluates a range of different future scenarios, and recommends a new 2050 Clean Energy Vision and Roadmap for Korea. It highlights that a much more ambitious low carbon future for Korea is both feasible AND desirable when considering all the latest possibilities, taking into account the economic, social and environmental costs and benefits, and considering optimum pathways for critical issues such as economic growth, energy security and human well-being.

President Moon Jae-in has already made encouraging first steps, with new plans and commitments to shift away from nuclear and coal, whilst setting increased targets for renewable energy. This report highlights that even more ambition is both needed and possible to transition towards a clean energy future.



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**Simon Yoon**  
CEO, WWF-Korea

**The changes needed are challenging but if we work together it is possible to make this happen.**



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**Manuel Pulgar-Vidal**  
Leader, WWF's Climate & Energy Practice

**We urge the private sector, government, academia and civil society to use these findings and take further decisive action.**

## KOREA CAN BE A WORLD-LEADER IN TACKLING THE CLIMATE AND ENERGY CHALLENGE

Today, unprecedented environmental pollution, climate change impacts, biodiversity declines and water scarcity are pushing the planet to a tipping point.

The recent G20 Summit in Germany highlighted the critical role of leading industrialized and emerging economies to deliver on their commitments toward ensuring sustainability and resilience for all. And this must be accompanied by concrete actions to bend the curve of accelerating climate change, staggering biodiversity loss and unsustainable use of the planet's natural resources.

Acknowledging the irreversible momentum set forth by the Paris climate deal, it is now vital that leading countries like Korea show determination to join countries and non-State actors worldwide in creating a global socio-economic transformation that will shape our national economies, people's well-being and prosperity for years to come.

The Republic of Korea is one of the world's largest greenhouse gas emitters however, like many other countries, its current reduction targets are considered insufficient to meet the global goals outlined in the Paris Agreement, which aim to keep warming below 1.5°C.

Implementing the Paris Agreement is in the interest of each nation. Effective action on energy can help unlock new business and employment opportunities, health benefits, and bring a sustainable future for all. Korea is well positioned to be a leader in this transition, bringing innovative new solutions to address the challenges both at home and globally.

Taking action is a shared responsibility - we urge the private sector, government, academia and civil society to use these findings and take further decisive action, implementing tangible measures to shift towards a clean energy future to help mitigate the worst impacts of climate change.

As key countries like Korea join cities, companies and individuals around the globe in committing toward a climate-safe future, it must be crystal clear that there is no place for fossil fuels in this scenario. We can be stronger together for climate but we need to translate ambition into action now.

An aerial photograph of a wind farm. In the foreground, the white nacelle and three blades of a wind turbine are visible, extending from the left side of the frame. The background shows a vast landscape of rolling hills and fields, dotted with numerous other wind turbines stretching towards the horizon under a bright blue sky with scattered white clouds.

**MORE ACTION IS NEEDED  
& POSSIBLE  
- TO SHIFT TOWARDS  
A CLEAN ENERGY FUTURE**

# CHALLENGES & OPPORTUNITIES

## WHY DO WE NEED ACTION ON ENERGY?

### ENERGY SECURITY: 95% OF ENERGY IS IMPORTED

Future energy security is a major risk to future prosperity and sustainability. We could significantly reduce our dependence on imports by providing diverse energy sources through energy transition.

### HEALTH & WELL-BEING: MAJOR CONCERNS

Human health & well-being is under increasing pressure from energy production such as air pollution (e.g. PM 2.5), water quality issues and uncertainty over nuclear safety. A happy & healthy future with cleaner air and water quality is possible if we take action.

### SLOW GROWTH: NEW ECONOMIC DRIVERS ARE NEEDED

Current growth is not sufficient. Other countries have shown that transitioning to a clean energy future can be a tremendous source of jobs and growth. Korea is well positioned to be a leader in this transition, bringing innovative new solutions to address the challenges both in Korea and globally.

### CLIMATE CHANGE: HOW TO STAY <1.5°C

Without significant reductions in greenhouse gas emissions (GHG), humanity will face global warming of up to 4-6°C which would have disastrous consequences. A significant reduction in GHG is possible. A global transition to clean energy is a key part of this. Every country has a responsibility to act – and Korea could jump from being a laggard to a leader for the world.

# CHOICES THAT WE HAVE THE ENERGY SCENARIOS

The study considered a range of possible future options for an energy transition by evaluating learnings and best practice from within Korea and also the most relevant examples around the world, and then selecting the following possible 2050 scenarios as the basis for the report.

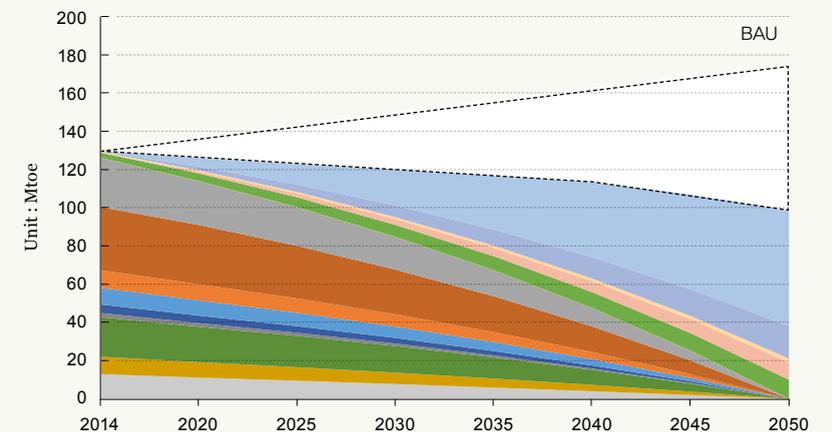
BUSINESS AS USUAL	MODERATE TRANSITION	ADVANCED TRANSITION	VISIONARY TRANSITION
<ul style="list-style-type: none"> <li>Continuation of current policies and trends</li> <li>&lt;10% energy supplied by renewable energy</li> </ul>	<ul style="list-style-type: none"> <li>7% reduction in demand compared to 2014 levels</li> <li>45% energy supplied by renewable energy</li> </ul>	<ul style="list-style-type: none"> <li>24% reduction in demand compared to 2014 levels</li> <li>55% energy supplied by renewable energy</li> </ul>	<ul style="list-style-type: none"> <li>24% reduction in demand compared to 2014 levels</li> <li>100% energy supplied by renewable energy</li> </ul>
			

### SO WHAT WOULD THIS LOOK LIKE?

For the visionary transition, the necessary shifts are shown below. Please see the full report for the other scenarios.

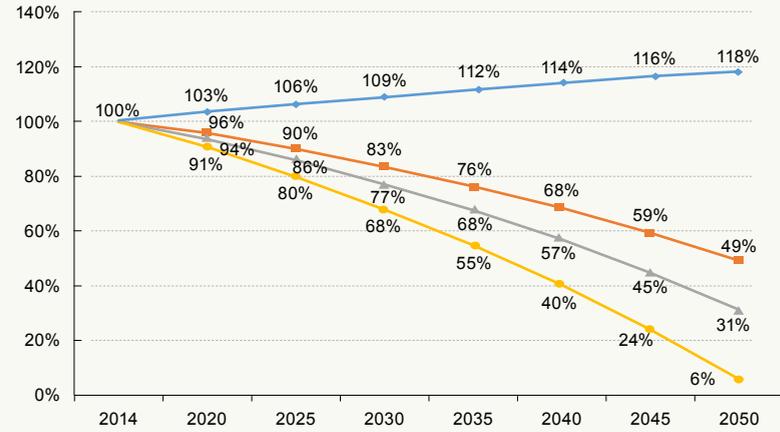
Final energy consumption levels are reduced by 24%, through a much more energy-efficient model placing a much smaller burden on the energy supply. The current dependence on nuclear, coal, natural gas and fuel oil in the energy sector is replaced with cleaner and safer alternatives – namely solar, wind and other renewables.

**Visionary Transition Scenario Final Energy Consumption**



## Greenhouse Gas (GHG) Emissions By Scenario

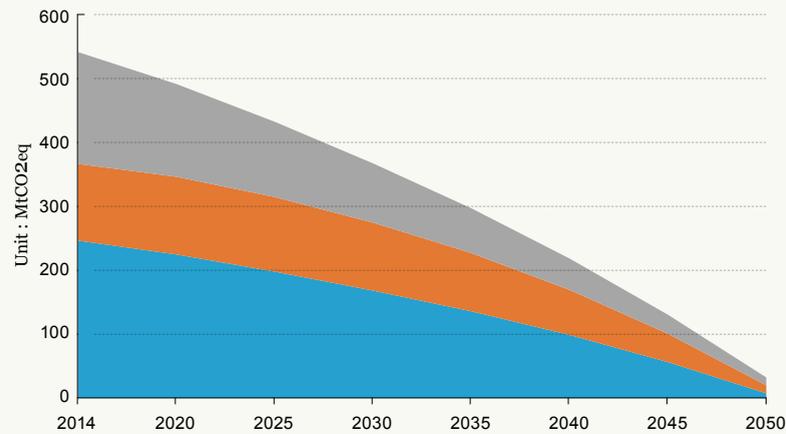
For the visionary transition, GHG Emissions are reduced by >90%, representing a major contribution to the fight against climate change. Necessary changes by sector are shown for the visionary scenario.



**GHG emissions reduction by scenario compared to BAU in 2014**

**Key**

- BAU
- Moderate
- ▲— Advanced
- ◆— Visionary



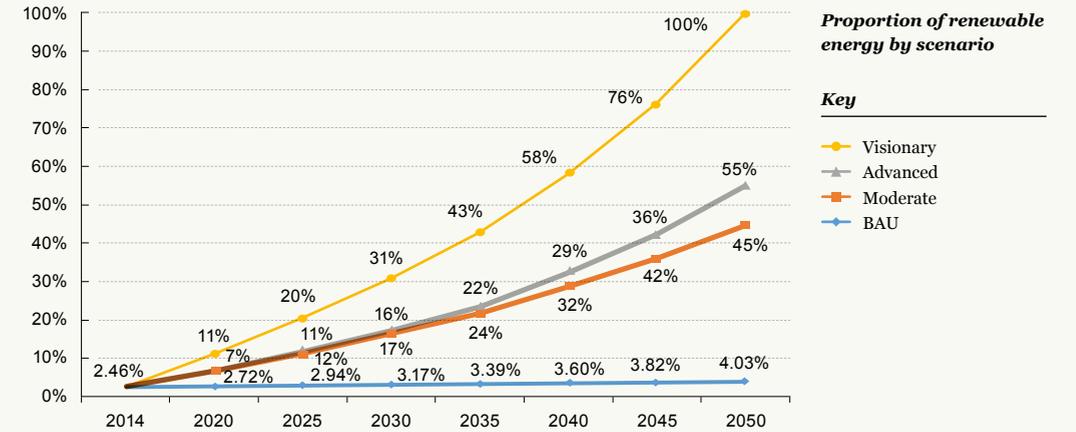
**Visionary Transition Scenario GHG emissions**

**Key**

- Industry
- Transportation
- Building

## Renewable Energy By Scenario

For the visionary transition, the renewable energy proportion reaches >30% of the overall energy mix by 2030, and 100% by 2050. The study shows that there is sufficient renewable energy potential to make this happen – it IS possible if we act decisively now. Towards the year 2050, energy imports are sharply reduced, increasing energy independence.



**Proportion of renewable energy by scenario**

**Key**

- ◆— Visionary
- ▲— Advanced
- Moderate
- BAU

# CHANGES WHAT CHANGES DO WE NEED?

The study shows that the Korea can technically meet its energy needs from renewable energy sources by 2050.

But what are the key changes needed to enable the transition? The report outlines a range of options from home and abroad, which now need further debate and prioritization by stakeholders to reach a detailed implementation plan.

However, in order to deliver the visionary transition, it is clear that the following key factors would need to be addressed:



## IMPROVE ENERGY EFFICIENCY

### Why needed?

Energy efficiency is a vital part of our vision. We can significantly reduce demand by improving energy efficiency and eliminating wasteful use of energy.

This can be done with existing technologies and capabilities and does not need to imply significant sacrifices in lifestyle.

Buildings is one key element, representing approximately 30% energy consumption and GHG emissions.

### What it means?

Overall

- Implement a new electricity pricing system that encourages energy conservation, promotes equity, and supports RE expansion;
- We need to strengthen minimum efficiency standards for all products that consume energy;
- Individuals, businesses and communities need to be more aware of the energy they use, and try to save energy wherever possible;
- Significant investment is needed into public transport to provide convenient and affordable energy efficient alternatives to private cars;
- Implement energy saving systems for industry.

Buildings

- Stronger energy efficiency criteria should be introduced for new buildings aiming towards near-zero energy use;
- Implement new standards for renovating existing buildings. Focus on highest impact buildings.

## TRANSITION TO SAFE & CLEAN ENERGY

### Why needed?

We should develop existing and new renewable energy sources to provide enough clean energy for all by 2050.

### What it means?

- Massively expand our capacity for generating electricity from renewable resources;
- Invest into smart grids to help manage energy demand and allow for a significantly higher proportion of electricity to come from variable and decentralized sources. Ensure successful multi-country implementation of the NE Asia Super grid;
- Implement improved Renewables Portfolio Standard (RPS), Feed-in Tariffs (FIT), RE capacity auctioning and net metering system;
- Improved power grid management to integrate variable renewable energy i.e. smart grids;
- Promote self-generation of renewable energy by all sectors. Expand farm solar power initiative;
- Expand renewable energy power options for energy consumers;
- Increase Government R&D investment into next generation technology development (RE generation, energy storage, etc).

## ELECTRIFY TRANSPORT

### Why needed?

Since electricity (as well as heat) is one of the forms of energy most easily generated by renewables and an energy efficient carrier, we need to maximize the use of electricity (and direct heat) in our clean energy solution.

Transport is a major part of energy consumption and GHG emissions, and hence a key focus for electrification.

### What it means?

- Enable cars, vans and trains to run on electricity; we need legislation, investment and incentives to encourage manufacturers and consumers to switch to electric vehicles;
- Improve fuel conversion and efficiency;
- Popularize eco-friendly vehicles.

# CHANGES HOW CAN WE MAKE IT HAPPEN?

Beyond the specific policy changes needed, there are other important enabling elements that need to be addressed:

POLICIES ALIGNED TO LONG-TERM GOAL	TRANSPARENT & PARTICIPATORY GOVERNANCE	INNOVATION ENVIRONMENT
<p><b>Why needed?</b> Immediate progress should be taken and maintained, with clear and ambitious targets for the short, medium and longer term.</p> <p><b>What it means?</b></p> <ul style="list-style-type: none"> <li>- Setting ambitious long-term targets and ensuring strong monitoring;</li> <li>- Provide clear policy direction and certainty.</li> <li>- Note: In the visionary transition, the report highlights that RE should represent at least 30% total energy supply by 2030.</li> </ul>	<p><b>Why needed?</b> Effective change will only happen with social consensus and effective participation of all parts of society.</p> <p><b>What it means?</b></p> <ul style="list-style-type: none"> <li>- Reform energy governance to foster social debate, to build a new energy vision with effective enabling systems and implementation plan;</li> <li>- Ensure effective linkages between all levels of government (central, provincial, civil, administrative);</li> <li>- Ensure effective 2-way engagement between government and business.</li> </ul>	<p><b>Why needed?</b> The energy scenarios are ambitious, but achievable if we can ensure a steady stream of new innovation.</p> <p><b>What it means?</b></p> <ul style="list-style-type: none"> <li>- Much like its experience in industrializing its economy, Korea must incentivize innovation and invest in human and institutional capacity to keep pace with frontrunners in the clean energy revolution.</li> </ul>

# CHANGES ENERGY SCENARIOS: COMPARING INVESTMENTS & BENEFITS

More detailed work with other stakeholders is needed to fully compare the investments and benefits involved in the energy transition. However, based on a pragmatic first assessment of the changes needed, and comparison of other country experiences, it is possible to highlight some broad and important differences between the scenarios.

In terms of benefits, the key areas to consider are energy security, economic growth, health/well-being and climate change.

**Key**

- ☺☺ This scenario is highly likely to bring the strongest benefits compared to the other scenarios between 2018-2050
- ☺ 2nd strongest option
- ☹ 3rd strongest option
- ☹☹ Weakest option

Scenario	2050 Assumptions	Relative Benefits Between Scenarios	
Business as Usual	<ul style="list-style-type: none"> <li>• Increasing energy demand as per current trends</li> <li>• &lt;10% energy supplied by renewable energy</li> </ul>	Energy security	☹
		Health & Well-being	☹
		Jobs and Economic Growth	☹
		Climate Change Mitigation	☹
Moderate transition	<ul style="list-style-type: none"> <li>• 7% reduction in energy demand</li> <li>• 45% energy supplied by renewable energy</li> </ul>	Energy security	☺
		Health & Well-being	☺
		Jobs and Economic Growth	☺
		Climate Change Mitigation	☺
Advanced transition	<ul style="list-style-type: none"> <li>• 24% reduction in energy demand</li> <li>• 55% energy supplied by renewable energy</li> </ul>	Energy security	☺☺
		Health & Well-being	☺☺
		Jobs and Economic Growth	☺☺
		Climate Change Mitigation	☺☺
Visionary transition	<ul style="list-style-type: none"> <li>• 24% reduction in energy demand</li> <li>• 100% energy supplied by renewable energy</li> </ul>	Energy security	☺☺☺
		Health & Well-being	☺☺☺
		Jobs and Economic Growth	☺☺☺
		Climate Change Mitigation	☺☺☺

## ENERGY SECURITY

Future prosperity is heavily dependent on a secure and affordable energy supply. Foreign oil and gas supplies are vulnerable to disruptions (such as conflicts, exporters' interests, etc) and so the level of energy imports has a major impact on energy security.

Towards the year 2050, the visionary transition is increasingly powered by domestically produced renewable sources, significantly reducing the risk of imports, and hence scores highly in terms of energy security related benefits. Business as usual and other scenarios have lower proportions of domestically produced energy and hence score lower.

## HEALTH & WELL-BEING

Korea has become one of the world's most polluted countries, with growing concern that much of the root cause is homegrown. A recent OECD report "The Economic Consequences of Air Pollution (2016)" highlighted that globally upto 9 million people per annum could die prematurely by 2060 as a result of air pollution, with Korea identified as being one of the hardest impacted countries.

Similarly, according to the same OCED report, Korea is forecast to suffer the highest level of economic damage from such factors, with costs estimated to be around 0.6% GDP by 2060 (OECD, 2016).

The report therefore assumes that scenarios with a stronger clean energy component will reduce root cause impacts such as burning fossil fuels and vehicle emissions, contributing to cleaner air and increased health and wellbeing benefits.

## JOBS AND ECONOMIC GROWTH

A new economic growth engine is needed for Korea. Current economic growth in Korea has been steadily declining since the 2000's, has fallen to around 3% levels since 2014, and some forecasts predict levels could fall to 1% in the coming years with its dire implications on jobs.

A clean energy transition offers a major opportunity for new jobs and growth. Renewable energy generates better quality jobs in higher numbers compared to fossil fuels. For example, almost 10 million renewable energy related jobs were created globally in 2016 (IRENA, 2017). Korea is well positioned to be a major player in this fast growing sector, with a strong workforce, advanced technologies and many other key capabilities.

The report therefore assumes that scenarios with a stronger clean energy component will have a higher potential to generate future economic growth.

## CLIMATE CHANGE MITIGATION

Significant reductions in greenhouse gas emissions (GHG) are needed to avoid the serious impacts of climate change.

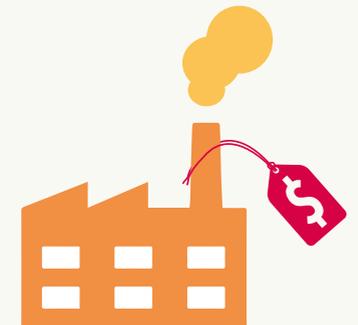
By 2050, the visionary transition reduces GHG emissions by >90% compared to 2014 levels and hence scores highly in terms of climate change related benefits. Business as usual would see GHG emissions rise >10%, while the moderate and advanced transitions would reduce GHG emissions by 51% and 69% respectively.

## INVESTMENTS

Major investments will be needed to drive the clean energy shift – for example, investments into solar and wind capacity, electrified transport options, and enabling infrastructure – whilst also exiting existing capabilities.

However - based on a pragmatic first assessment and learning from the experiences of other countries - with smart and innovative planning, and leveraging best available technologies, the investment levels from 2018 through 2050 are affordable for all of the transitions.

The report highlights that the overall cost of the new transitions are only a small increase compared to business as usual.



# CHANGES PROMOTING SOCIAL ACCEPTANCE

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Our society has had the opportunity to realize the risks and harmful effects of nuclear power and fossil fuels, from the Fukushima nuclear power plant accident in Japan to the current fine dust issues. The consensus on the need for a safe and sustainable energy transition is probably greater than ever before.

This is important since the change will need the active participation and buy-in of all parts of our society. Some of the changes may be challenging, not everyone will be supportive, so it will be important to enable a transparent, participatory process where the issues can be discussed, and to provide the right support to enable the necessary transition plans to happen.

Major renewable energy expansion is viable but it can only be achieved if there is a social consensus that this is right path for Korea. Currently there are some barriers to overcome such as a lack of understanding and awareness on its potential and benefits, insufficient governance, policy uncertainty and a lack of citizen participation.

Hence, this report aims to provide a framework that addresses all the critical change elements – from strengthened policies, to improved governance and active social participation.

Renewable energy needs to be re-framed in society as the mainstream solution for the future, not just a secondary or minor part of the mix. If policy efforts and social response are combined to raise social acceptance, then the necessary breakthrough can be achieved.



# CONCLUSIONS THE WAY FORWARD

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A clean energy future is possible if we act decisively now.

By 2050, Korea's power sector could be 100% powered by renewable energy - representing a safe, secure and sustainable energy future. This would be better for energy security, jobs, growth, health and a critical contribution to the world's effort to avoid catastrophic climate change impacts.

The transition to a 100% renewable power sector will require many steps.

And we will need everyone – individuals, communities, businesses, investors, politicians – to act immediately and boldly.

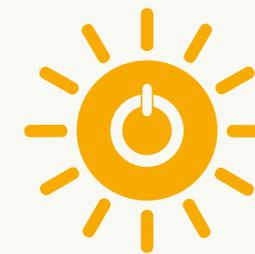
Although ambition levels are rising with the arrival of President Moon and the new Government, which is highly welcomed, this report highlights we have to push ourselves even further, higher and faster to achieve the kind of future that Korea's deserves.

Korea is in a great situation to capitalize on this situation, and well positioned to become a world leader if it chooses the right path now. The vision outlined in this report, to build a much more energy-efficient country, underpinned by clean energy is clearly achievable.

The report starts to lay out how we can do this. It is not a finished product - it raises many challenges and difficult questions. But it shows that solutions are available. The scenarios are presented to catalyze debate and to spur the nation to action.

WWF believes the visionary transition outlined in this report is both possible AND the best pathway for Korea's future, and is ready to support the discussion and transition.

We now need to respond to the issues it raises. We need to take it further. But most of all, we need to act on it – each and every one of us. Starting today.



**A clean energy future is possible if we act now**

# REPUBLIC OF KOREA 2050 ENERGY STRATEGY FOR A SUSTAINABLE FUTURE

## KOREA ENERGY VISION 2050 IN NUMBERS

100%

Proportion of renewable energy in the energy sector in 2050

24%

24% energy demand reduction in 2050 compared to 2014



>90%

>90% GHG emissions reduction in 2050 compared to 2014



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As a values-driven company with a passion for life at home, IKEA has focused making a positive impact on people and planet by economising with resources and helping to create a better everyday life for the many people.

	<p><b>Why we are here</b> To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.</p> <p><a href="http://wwfkorea.or.kr">wwfkorea.or.kr</a></p>
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