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[Minister Choi, His Excellency Jung], distinguished guests, ladies and gentlemen, let me begin by thanking KETEP [Korea Institute of Energy Technology Evaluation and Planning], in particular, Dr. Lee [Joon-Hyun Lee, President, KETEP] for this opportunity to talk to you today. I am delighted to be here. What a fitting place to be talking about the future of green growth and innovation in energy technology - here in Korea, a country that is leading the way in terms of efforts toward low-carbon or 'green' economic growth, and at an event hosted by KETEP, created in May last year to drive innovation and R&D in energy technology.

[MKE Minister Kyung-Hwan Choi and Jang-Sun Jung, Chair of the Committee of on Knowledge Economy, National Assembly may be in attendance.]

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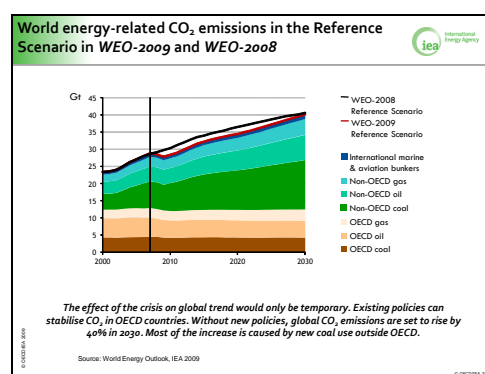


I want to share with you today some of the IEA's key findings on the future for low-carbon energy technology and its potential contributions to green growth, but first, let me tell you a little about the IEA. Founded during the oil crisis of 1973-74, the IEA's initial focus was on oil security. In particular, its role was to coordinate measures in times of oil supply emergencies, like Hurricanes Katrina and Rita and the first Gulf War.

But the Agency's mandate has broadened over the years as the energy landscape has changed. We are now working with member governments on a much wider range of policy issues, helping them to support their economies with secure, environmentally acceptable energy. This reflects the reality that energy is now a central concern across most areas of policy making. It is a driver of economic growth, a necessary tool for scientific research, for social development, indeed for human well-being. And yet when used in the wrong manner, it can contribute to geopolitical and economic instability, as well as environmental degradation.

So as its importance to global policy making continues to rise, let me share some thoughts on the contribution that the energy sector can make to achieving green growth and, in particular, the important role of low carbon energy technologies and technological innovation in delivering a more secure and sustainable future for us all.

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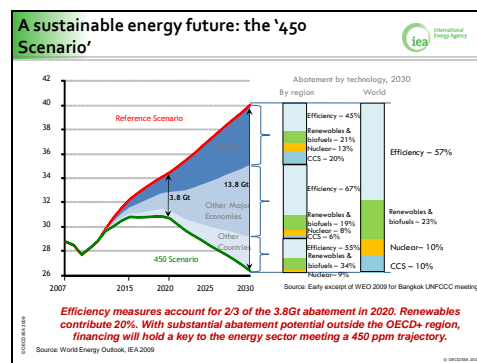


In doing so, we must first start with the context. Where are we currently headed? What does the future hold if we do not change our actions? In short, we are currently headed down an unsustainable path: based on existing government policies alone, global energy use will increase by 40% by 2030: mainly more coal and more gas as well as more oil.

This is not good for energy security. But moreover, it equates with a 40% increase in CO₂ emissions to over 40Gt by 2030. This trajectory is quite simply unsustainable - economically, socially and environmentally.

We need a transformation in world energy to decouple economic growth from CO₂ emissions, and we must begin now. The good news is that thanks to the global economic crisis, in cumulative terms to 2030, global emissions are projected to be 35 Gt lower than projected in 2008. This gives us a renewed motivation to act and economic stimulus measures can and are being directed toward a lower-carbon future, with Korea itself being a leading example here.

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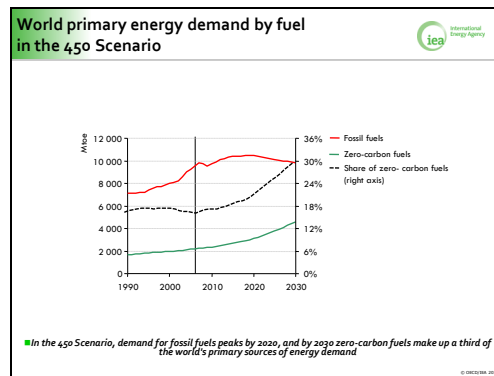
So what might a lower carbon future look like, what role will energy technology play and how do we get there? At the IEA, we take these questions very seriously. Our *World Energy Outlook 2009* set out the '450 Scenario' - the IEA's own low-carbon energy path to Green Growth. This scenario shows how the energy sector can help to limit the concentration of CO₂-equivalent emissions to 450 ppm - roughly equating with a temperature rise of 2 degrees Celsius by the end of the century. The red line at the top of this graph shows the trajectory for Reference Scenario - or business and usual - emissions, while the green line shows that for the 450 Scenario.

The 450 scenario sees CO₂ emissions peak before 2020 at 30.9 Gt (3.8 Gt less than in the Reference Scenario) and fall sharply thereafter, reaching 26.4 Gt in 2030 - equivalent to 13.8 Gt of abatement relative to the Reference Scenario in 2030.

What you see here is the kind of technology efforts needed to achieve the 450 Scenario. Sometimes referred to as "The Quiet Giant", energy efficiency is the single most significant element, the 'low hanging fruit', but renewables, nuclear and CCS are also crucial. The graph also shows that two-thirds of the reduction should most cost-effectively happen in non-OECD countries, though that of course is different to the question of who should pay for and support such actions..

In short, to make this future a reality requires a revolution in the way that we produce and use energy. But there can be significant energy security benefits from this scenario: using energy more efficiently and accelerating the switch to low-carbon or zero-carbon energy sources should see reduced import dependency, increased diversification of energy sources and lower energy bills - all important elements of a green growth strategy.

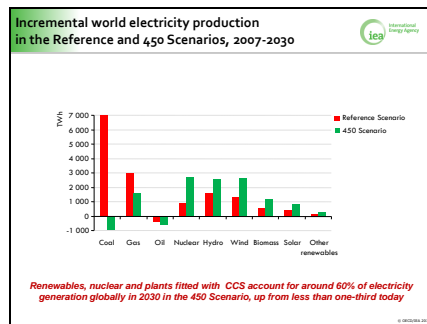
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This graph shows clearly how the 450 Scenario not only enhances environmental sustainability, but also energy supply security. While the debate about "peak oil" may continue, in the 450 Scenario, we could first see a "demand peak". As shown here, demand for fossil fuels should peak by 2020 to make this scenario happen.

Let us not be mistaken however: even in such a revolutionary scenario, we would still remain heavily dependant on fossil fuels, which would account 68% of primary energy demand in 2030. Let me say in this regard that I appreciate that in establishing KETEP, the Korean government had in mind not only questions of environmental sustainability but also energy security, particularly in the face of the 08-09 oil price volatility. I applaud the government's acknowledgement that these issues can and should be addressed together.

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But while fossil fuels will remain the dominant energy source, we will still see huge transformation, including in the power sector. This slide shows the dramatic change in the 450 Scenario in terms of electricity production. In 2030, around 60% of global electricity production would come from renewables (37%), nuclear (18%) and CCS (5%). This represents a step-change from the Reference Scenario where fossil fuels still account for about two-thirds of generation.

But this will be a huge challenge. We need (annually, 2010-2030):

Coal CCS = 11 CCS Coal -fired plants (800 MW)

Gas CCS = 5 CCS gas-fired plants (500 MW)

Nuclear = 18 Nuclear plants (1000 MW)

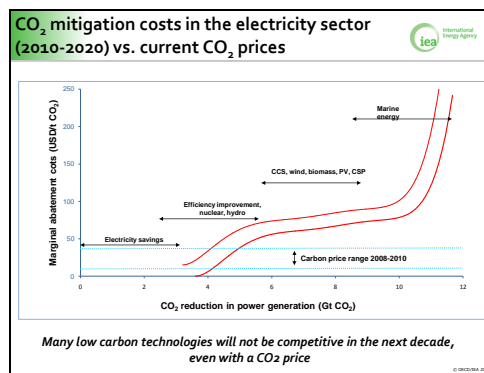
Hydro = 2 Three Gorges Dams

Wind = 17,000 Wind Turbines (3 MW)

Solar = 94 CSP plants (250 MW)

Biomass and waste = 270 CHP plants (40 MW)

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So having described a low-carbon future, let's talk now about what we need to do to develop and deploy the most vital low carbon energy technologies?

The IEA has long believed that any successful policy framework for reducing CO₂ emissions is going to be made up from a number of elements including carbon pricing (e.g. through cap and trade schemes), national policies and measures and sectoral approaches. While top-down targets that put a price on carbon are an important part of the picture, they alone will not deliver the technology revolution that is needed.

Firstly, it is unlikely that the vast majority of countries outside the OECD are ready to carbon pricing and secondly, even for those countries that do, the level of prices that we have seen and are likely to see in the next decade will not on their own be sufficient to drive investment in the more costly technologies that have longer-term emission reduction benefits, as shown in this graph.

Therefore, to avoid locking in inefficient, carbon-intensive technologies during the next decade, governments will need to intervene with targeted technology policies to bring down the cost of low-carbon alternatives and to create markets for technologies that are not yet fully commercial. We are seeing more and more governments pursue just this sort of strategy and we applaud the Korean government's own efforts in this regard.

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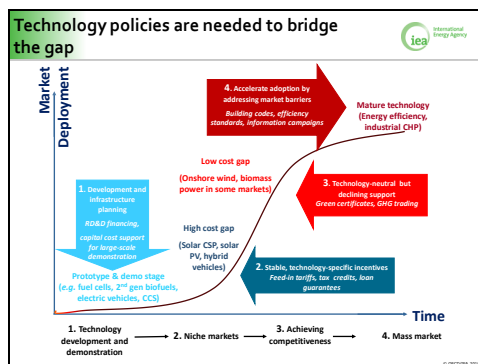
Sample CO ₂ savings in 2020 due to energy technology policies		
Country/region	Policy target in 2020	Savings in 2020 vs Reference Scenario - Mt
US	Fuel economy standards	129
EU	Fuel economy standards	111
China	+6% power capacity from low carbon sources	398
China	Sectoral standards for iron & steel, cement	230
Russia	Nuclear power	31
South Africa	More efficient coal	16
Middle East	Efficiency standards for AC, lighting, motors	33
India	110 GW renewables capacity	76
Japan, EU, US	Buildings efficiency standards	79
Totals (all actions - 2009 World Energy Outlook)		2 098

This slide shows some of the policies that countries are introducing to accelerate the development and deployment of low carbon energy technologies. These include renewable energy mandates, nuclear energy strategies and efficiency and fuel economy standards.

Therefore while it was difficult to get a global binding agreement to reduce GHG emissions in Copenhagen, many countries are nevertheless pursuing strong energy technology policies that are delivering real CO₂ emissions reductions today. Indeed the actions shown here total over 2 Gigatonnes of CO₂ reductions. In this

regard, what is happening within countries is as crucial right now as the ongoing international negotiations.

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So what kind of technology policies should countries be introducing to achieve widespread deployment of existing low carbon technologies and drive innovation in those still under development? The answer is that the approach must be tailored to the maturity of each technology and its market.

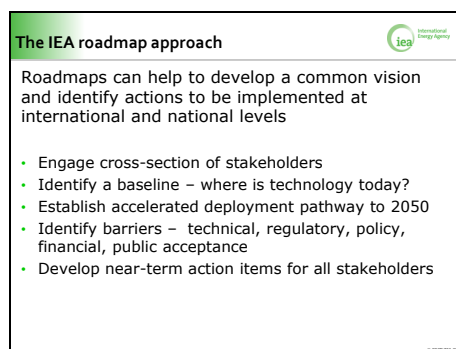
During the prototype and demonstration phases, technologies need to be supported by RD&D support or funding for demonstrations (e.g. CCS, second generation biofuels, fuel cells).

More mature technologies that are still expensive (solar PV, CSP, hybrid vehicles), need a stable and long-term support framework that allow industry to improve performance and reduce costs, such as feed-in tariffs, tax credits, loan guarantees.

For more advanced technologies (onshore wind, biomass), we must move toward more market-oriented incentives such as Tradable Green Certificates or GHG emissions trading.

Once the technology is close to competitive (industrial CHP, hydro, energy efficiency), specific support systems can be phased out and if an appropriate carbon price exists, these technologies can compete on a level playing field with others, providing that non-cost market barriers are addressed.

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The IEA roadmap approach

Roadmaps can help to develop a common vision and identify actions to be implemented at international and national levels

- Engage cross-section of stakeholders
- Identify a baseline – where is technology today?
- Establish accelerated deployment pathway to 2050
- Identify barriers – technical, regulatory, policy, financial, public acceptance
- Develop near-term action items for all stakeholders

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So we've talked about the need for supportive policies in general, let's take a look now at some specific technologies. In order to help identify exactly what each individual technology needs to accelerate its development and deployment, the IEA is drafting a series of international technology roadmaps.

So far we have produced 5 roadmaps (CCS, wind, solar PV, electric and hybrid vehicles and cement), with another 12 or so on the way.

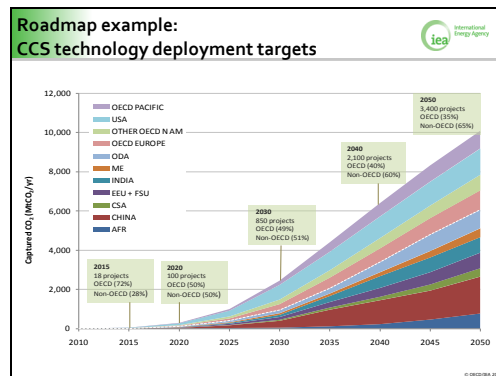
Our approach involves engaging experts to understand where we are today - in terms of installed capacity, cost, and performance. Which countries are leaders and what can we learn from them?

We then use our scenario analysis to set a vision for this technology's long-term role in achieving GHG mitigation. For instance how much wind capacity will we need by 2050 if we are to halve global CO₂ emissions by that date.

We then identify barriers to achieving this potential - technology development/R&D, policies, investment needs, public acceptance etc.

Finally, each roadmap includes a set of specific, near-term action items and milestones to guide implementation. Importantly, these roadmaps are developed with partners in industry and government, in both IEA and non-IEA member countries, including KETEP itself.

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Here is one example - from our CCS roadmap.

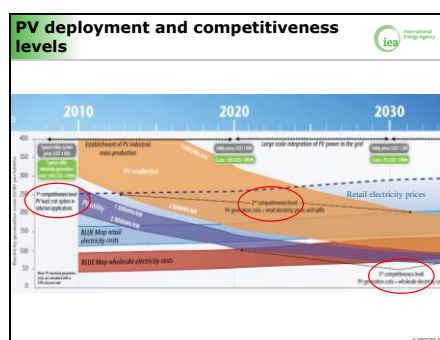
For years, we have been talking about the importance of CCS, and have said, we will need a lot of CCS, and it will cost a lot. The CCS roadmap, for the first time, puts numbers and figures around our global goals for CCS. I want to highlight that the roadmap is just one scenario - driven by the goal of halving CO₂ emissions by 2050. But we feel it is an important contribution to the debate, as it provides details and specifics - about how many projects we will need, where these projects will need to be located and which sectors will need to install CCS.

The G8 leaders in Japan in 2008 committed to announce 20 large-scale CCS projects by 2010, with a view toward commercialisation by 2020. Well this roadmap estimates that we will need 100 large-scale projects by 2020.

The other point to note from this graph is where the projects will need to be installed. You can see that OECD countries must lead in the first decade, but the technology must quickly expand to the developing world, where we see the vast majority of emissions growth. By 2050, fully 65% of the projects must be located in non-OECD countries, according to our estimates. This will require a step change in CCS development aid *and* capacity building.

As to the additional investment needs for CCS - those over and above business-as-usual plant investments - these total USD 2.5-3 trillion by 2050. This is a huge number, but in fact is only 6% of the total additional investment associated with halving emissions by 2050.

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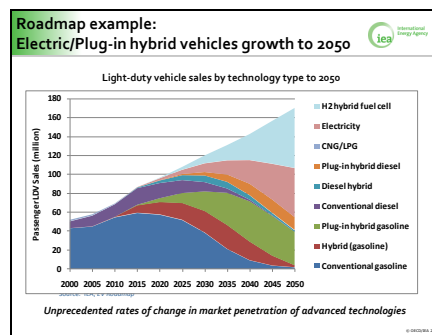


This slide is from our Solar photovoltaic (PV) roadmap, another key energy technology for the future. Our analysis shows that PV power is a commercially available and reliable technology with a significant potential for long-term growth in nearly all world regions. As this

graph shows, in the 450 Scenario, by 2050, PV will provide around 11% of global electricity production (3000 GW capacity; 4500 TWh; by 2030, 5%) and reduce 2.3 gigatonnes (Gt) of CO₂ emissions per year.

But the key issue here is cost. Residential PV will achieve competitive parity with the power grid by 2020 in many regions (those with adequate sun and relatively high electricity prices) and by 2030 for utility PV. But achieving this will require a strong and balanced policy effort in the next decade to allow for optimal technology progress, cost reduction and ramp-up of industrial manufacturing for mass deployment. As grid competitiveness is achieved, the policy framework should evolve towards fostering self-sustained markets, progressively phasing-out economic incentives but maintaining priority access to grids and sustained R&D support.

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Here is another example, this time from our EV roadmap.

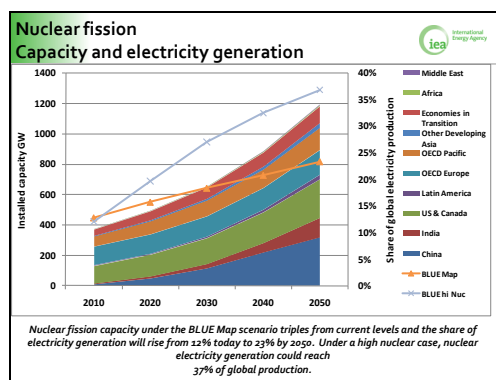
In the past, when talking about the low-carbon pathway to 2050, I have called for an energy technology revolution. Well now, I think we see signs that a transition has already begun in certain sectors and I think electric vehicles is one such example. What might have seemed like science fiction only a decade ago is now becoming reality. We are seeing more and more EV models coming to the market, and manufacturing plans announced for batteries and vehicles. Though what we also really need to for EVs to be viable on a large scale is extensive use of zero carbon electricity. The next five years will be critical, but it seems quite possible that with the right coordination of policies and players, we will go through an extensive demonstration and deployment phase.

Our advanced vehicle roadmap to 2050 seeks to make that revolution a reality. With the right combination of policies, we can see unprecedented rates of market penetration for advanced

technologies, with OECD countries, China and India playing leadership roles in achieving this transition.

Let me take a moment here to mention that the IEA will release a smart grid roadmap in late 2011. We appreciate that Korea is leading the way in efforts to roll out this technology, through its co-chairing of the MEF smart grid technology group and through domestic activities at JeJu Island, among others. I know my staff have already been in touch with relevant groups here and we look forward to collaboration in this field.

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Together with the NEA, we are also developing a nuclear energy technology roadmap, to be released this summer. I appreciate that Korea is a leader in nuclear energy so want to touch on a few of the key findings here.

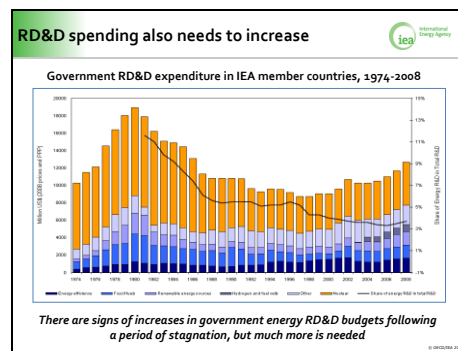
This preliminary graph shows that nuclear capacity under the IEA's low-carbon scenario [BLUMap = 450] triples from current levels

and the share of electricity generation will rise from 12% today to 23% by 2050. Under a high nuclear case, nuclear electricity generation could reach 37% of global production.

Other key findings in our nuclear roadmap are:

- Nuclear is a proven technology and can play an important role in a low-carbon strategy.
- However, political support and public acceptance are vital to implementing a nuclear program and I note the strong recognition of this here in Korea.
 - In addition, the financing of nuclear remains a key challenge. Nuclear projects are capital intensive, involve the management of high amounts of capital at risk and the current economic circumstances make financing difficult.
- Ensuring a sufficiently large and skilled nuclear workforce also remains a real challenge that must be addressed collectively.
- And finally, GEN IV technologies could reduce costs and improve performance and security, so should be supported.

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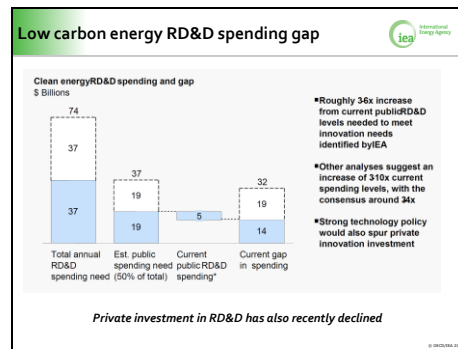


Having drawn on examples for specific technologies, I want now to touch on F&D - an issue that I know is of central concern to KETEP. To achieve the roadmap targets I have just been talking about, we must urgently increase low carbon energy RD&D spending.

What you see here is that recently we have begun increase public R&D spending in IEA countries after many years of decline. This is due, in part, to the "green growth" financial rescue packages that were passed in 2008-09 and Korea itself is a clear example.

Even so, in real terms, we are still only back to the spending levels that we were at in the mid 1980s. Yet, many governments, including here in Korea, are recognising that they must do more. At the IEA Ministerial meeting in October last year, IEA countries declared their intention to double RD&D spending on low carbon technologies by 2015.

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So would such a doubling be enough? We think its certainly a very good start. But it is likely that even more will be needed.

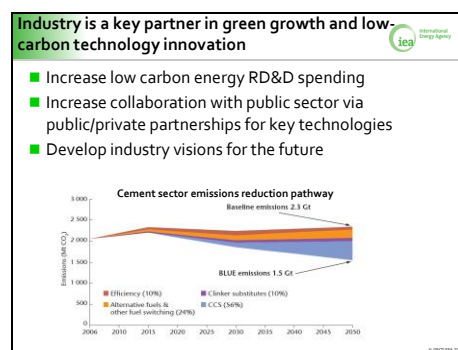
We recently performed a study for the MEF or Major Economies Forum, that was released in Copenhagen last December. We looked at a selection of key low carbon technology areas—including solar energy, CCS, advanced vehicles, smart grids and others. We identified current public spending levels, then compared these against priorities and needs through to 2050.

The results of our analysis are presented here, in a graph that US Energy Secretary Chu used in his own COP15 presentation. We found the total low-carbon energy RD&D needs to be between 37- 74 billion dollars annually. If we assume that 50% of this spending should be public sector spending, that range is between 19-37 billion annual spending.

We are currently spending about 5 billion/year on these technologies [the USD 12 billion total shown on the last slide is for all energy

RD&D, not just low carbon technologies and includes around 4 billion on nuclear]. This means the gap is between 14-32 billion/year, which in turn means we need to increase public spending to 3 - 6 times current levels! So a doubling of public spending by 2015 is good but a real low-carbon, green growth path will require even more.

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Having mentioned the need for public spending, let me also emphasise that industry is a key partner in powering green growth. They fund RD&D, develop new business models, educate consumers and make key technologies available at low-cost.

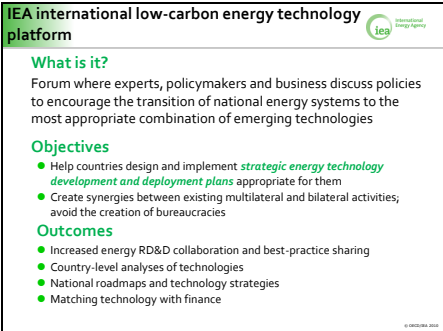
However, our latest figures show that private investment in low carbon energy RD&D declined in 2009, no doubt due to the financial crisis. We are therefore calling upon the private sector to increase its investment in low carbon technologies as well.


The IEA roadmaps have also identified a need for governments and industry to work more closely *together* in support of technologies that have a large future potential but are currently unable to

attract significant investment. Public-private partnerships aimed at speeding the transition from demonstration to commercial deployment can help. Such partnerships may be particularly appropriate for technologies such as CCS and EVs that depend on the development of new business models for industries and technologies

Industry sectors can also help advance low-carbon energy technologies by working collaboratively to develop visions for the future. The publication in 2009 of a joint IEA-cement industry roadmap shows how industry can provide leadership and guidance to government and civil society about the actions that need to be taken to transition to a low-carbon future. We would like to see more sectors step up and show this sort of leadership.

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IEA international low-carbon energy technology platform 

What is it?
Forum where experts, policymakers and business discuss policies to encourage the transition of national energy systems to the most appropriate combination of emerging technologies

Objectives

- Help countries design and implement *strategic energy technology development and deployment plans* appropriate for them
- Create synergies between existing multilateral and bilateral activities; avoid the creation of bureaucracies

Outcomes

- Increased energy RD&D collaboration and best-practice sharing
- Country-level analyses of technologies
- National roadmaps and technology strategies
- Matching technology with finance

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Finally, in addition to government action on technology policy and industry leadership, there is an urgent need to ramp up international low carbon energy technology collaboration.

With the agreement to establish a new technology mechanism for development and deployment, COP15 re-affirmed the importance of technology in addressing climate change, especially because of inadequate investment in low-carbon technologies.

To address this need, the IEA is doing its part by preparing a low-carbon technology platform. The platform, which was endorsed by the IEA Ministerial meeting in October, will bring together policy makers, business representatives and technology experts to discuss how best to encourage the spread of clean energy technologies

The IEA will bring its roadmaps and energy technology work together, with the guiding principle to optimise available resources by creating synergies among existing activities rather than adding new bureaucracies. In this regard, we look forward to working with relevant Korean bodies such as KETEP and the GGGI.

The platform will aim to take national and regional action on specific technologies to implement the roadmaps, and provide capacity building support where needed.

The first high level meeting of the Platform will take place in October this year.

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The good news:
The low carbon transition has begun... 

- > **Globally:**
 - **USD 250 billion** of additional low-carbon funding committed by G20 governments as part of national stimulus packages
 - MEF and IEA countries aiming to **double public RD&D** spend on low carbon technologies by 2015
 - **Wind has overtaken natural gas** as the number 1 source of new power capacity installed in Europe (39% to 26%)
 - Funding of **>USD 10 billion** committed to >12 large-scale **CCS** demo projects
 - Global electric vehicle targets total **10 million LDVs in 2020**
- > **Korea:**
 - Goal to reduce GHG emissions by 30% from business-as-usual by 2020
 - Green Growth 5 Year Plan (2009) will spend USD 87 billion to reduce emissions and develop cutting-edge technologies

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So let me wrap up with a word of hope then of caution.

First, the good news. In a number of important areas we can see signs of the energy technology revolution that we have been calling for...

There has been a substantial increase in the funding of low carbon technologies as part of the stimulus packages

Governments are committing to spend more on RD&D


In many countries and regions we are seeing increased deployment of renewables.

Funding announcements are being made to support **CCS** demonstrations.

Companies and governments are announcing ambitious plans for the roll-out of electric vehicles

These global trends are mirrored here in Korea where the government has announced an ambitious goal to cut GHG emissions by 2020 and backed this up with substantial funding for low carbon technologies.

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But ... this transition must be accelerated

- Over next 10 years, **additional USD 2.2 trn** must be invested in the global energy sector to deploy needed low-carbon technologies
- Need to **reduce global energy demand by 14% by 2030** compared to reference scenario
- Need to **more than halve the CO₂ intensity of global electricity by 2030**
 - Around 100 CCS plants in power generation, fuel transformation and heavy industry by 2020
 - More than 400 GW of additional wind power needs to be added by 2020, more than three times the current installed capacity
 - Nuclear generation needs to double by 2030
- **Smart grids and a recharging infrastructure** need to be rolled out to support deployment of electric vehicles

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But now the note of caution. While this news is encouraging - we need to lock in and accelerate this revolution. All sectors and stakeholders must participate.

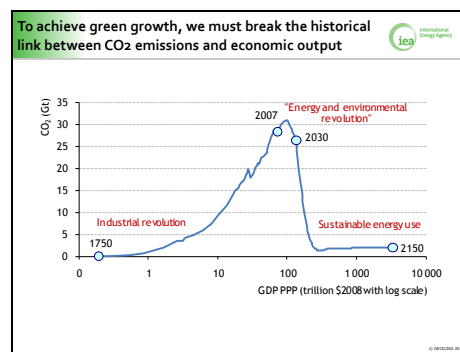
This means governments must maintain stimulus package spending on green growth *and* then expand spending for key technologies.

We must maintain and enhance our focus on energy efficiency - often the cheapest and easiest ways to reduce emissions while also cutting fuel costs - a true green growth measure.

Change in the power sector needs to be accelerated so that we can halve the global intensity of electricity production over the next 20 years.

And significant infrastructure projects will need to be put in place such as smart grids and recharging infrastructure to support the deployment of electric vehicles.

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Ladies and gentlemen, achieving green growth will mean breaking the historical link between CO₂ emissions and economic output.

This will require a massive acceleration in low-carbon technology innovation and deployment. To do this, we need truly global cooperation: Governments must ensure supportive policies as well as public spending. Industry must provide new business models and more investment. Academic institutions must ramp up education programmes to create the clean energy work force we require. NGOs must educate the public on the need to accept low carbon infrastructure in their communities. And we must *all* work together

to accelerate the transition, by sharing information on best practices, policies and collaborative research, demonstration and deployment.

Ladies and gentlemen, Korea has lead the way in viewing the recent economic turmoil as an opportunity to stimulate a recovery based on green growth. The 2009 5-year *Green Growth Plan*, the recent enactment of the 'Framework Act of Low Carbon, Green Growth', and indeed, the very creation of KETEP itself, provide an exemplary case for innovative and proactive government policy towards sustainable development. Korea has recognised, as the IEA has, that the energy sector lies at the heart of the achieving these outcomes.

Let's tackle the challenges *now* to ensure a sustainable and secure energy future. The beginnings of the energy technology revolution can be seen, now let's make that revolutionary future a reality together. Thank you.