Frederic Hauge presentation outline
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The challenge:

- 80% of world energy consumption is based on fossil fuels.
- One third of the world's growing population does not have access to electricity.
- The large majority of the world has a rightful need to increase their standard of living, and therefore their energy consumption.
- And at the same time, we need to reduce greenhouse gas emissions substantially.

We have a job to do! → The Bellona Scenario

- The IPCC tells us we need to go to avoid the most dangerous consequences of global warming: a 50 to 85% reduction in emissions by 2050. The graph shows an 85% reduction to 2050.
- At the same time, we are heading straight in the wrong direction. The IEA predicts that emissions will increase by 75 percent by 2050. That's if business is allowed to continue as usual.
- Now, this is a tremendous challenge – the gap is wide. Several scenarios have been published that show how part of the gap can be filled, but we were disappointed with the fact that few, if any, seemed to go all the way.
- So we in Bellona asked ourselves: Is it not possible to fill the gap?
- Across the economy, we searched for solutions that already are available, or on the verge of becoming so.
- We analyzed findings from both scientific publications and various reports prepared by industry and environmental organizations.
- And the result is encouraging: it is possible to reduce emissions by 85%. But there is no single solution that can do the job alone. A full range of solutions are necessary.
- With this, we are not trying to accurately predict the future. Our objective is to illustrate that combating global warming is manageable – that it IS possible to fill the wide gap between demand for energy and reduce CO_2 emissions.
- Let me now show you some of the exciting technologies that we can use to build a zero-emission future!

The first and easiest thing we can do is to use energy smarter

- We could for example live and work in houses that need very little energy, and the little you need could come from the sun that shines on your roof!
- You could even produce enough to charge your electric car.
- We got our first electric car in 1989.

- Today we have electric sports vehicles – one of these are parked right outside!

- And more are coming; it finally seems like the car industry is waking up to the new dawn. Plug-in hybrids are around the corner, and several major car companies are producing their first electric cars as we speak.
- In the future, zero-emission vehicles would be available in all market segments, with equal or better performance than the polluting vehicles of today.

How do we power the zero emission society?

Renewable energy

- Clearly a renewable energy system is our ultimate goal: In the Bellona Scenario – 90 per cent power in 2050 will be from renewable energy sources.
- Solar energy, bioenergy, wind and hydro are the main sources we have included, but other renewables, such as geothermal and wave energy might get substantial market shares.

Fossil energy

- But, today we are far away from the renewable energy system – coal, gas and oil is totally dominating.
- Fossil energy is widely distributed across the globe, and all scenarios predict fossil fuels will continue to play a major role in fueling a growing world population
- That's why we started looking for ways to clean fossil energy – already in 1992. What we found was carbon capture and storage –capturing CO_2 from power plants and industrial sites.
- People laughed at us for many years, and some still do
- Today, 16 years later, politicians and industry are ready to start
- In Europe, 30 or so pilot plants are planned in Europe alone – and hopefully 10- 12 full scale plants will be in operation by 2015. And similar projects are being developed in North-America, Australia and Asia

But: coal will never be sustainable – can we find a sustainable substitute?

- Let us replace fossil carbon with "fresh" carbon! Coal and gas was formed millions of years ago as carbon at that time was buried in the form of dead plants. Today, we can bypass the fossil stage and use the biomass directly for energy.
- Of course, we must produce biomass without compromising food supply or the environment. There is a HUGE global potential for sustainable biomass production.
- One exciting new opportunity is large scale production of algae.
- Algae are the fastest growing and most flexible organisms in the world. There seems to be an algae for EVERYTHING.

- And it can be produced efficiently in a very large scale, in industrial “bioreactors” like these
- It could also be produced on a small scale like in a household. Again, algae are very flexible!
- The algae can then be used for a variety of energy uses, such as biofuels for transportation. Our dialogue with the aviation industry is inspiring is very inspiring in this respect – the most innovative of them are moving forward! Such as Richard Branson and Virgin.
- Or we could use them to produce electricity.
- Like all biomass, algae absorb energy from the sun and CO_2 from the air as they grow. This gives us a lot of exciting opportunities!
- We could use algae to capture CO_2 emissions from power plants and industrial sites all over the world.
- We can then use the algae to produce electricity in power plants. This would allow us to **recycle** the carbon, and use if for energy production several times.
- Other renewable energy sources, such as wind and solar energy, are intermittent – which means that they need large scale energy storage.
- Algae could be a large scale solution to this problem. They could store energy from the sun and CO_2 from the air, and then be used to generate energy when the wind is silent and the sun is gone.
- Algae could also allow us to transport fossil carbon from sites all over the world to locations suitable for geological carbon sequestration.
- And even more exciting – if we use algae and other modern biomass to produce energy in plants fitted with CCS, we could create a **negative** CO_2 emission!
- So the more you drive your electric car to visit friends and family - the more CO2 you remove from the atmosphere.
- There is sense of good morale in this. The western countries have contributed the most to create the problem – therefore we should to the most to combat it.
- The lower we manage to go, the more we give room for developing countries to use energy to increase their standard of living. Going negative makes a lot of sense from this perspective.
- Algae could also let us create a global market for bioenergy. Developing countries could produce algae and clean their emissions at the same time, and then export whatever they didn’t need themselves to richer countries. Just think about the huge value export of oil, the **black gold**, is creating now – maybe algae is the new **green gold** for developing countries?

The Bellona Scenario shows: Combating global warming IS possible – 2 min

- This is not just a wild dream – all these technologies already exist.
- And lots of exciting new solutions are out there waiting to be discovered.

- Okay, a zero-emission society can seem hard to reach. But then,
- Who could, in 1960, believe that man would walk on the moon less than a decade later?
- In fact – many doubted that it was possible – some even laughed at the idea.
- But – this vision is within reach! Combating global warming **IS** possible!!

Closing up

- We have taken on huge challenges before.
- War time history shows that virtually nothing is impossible.
- And this is where the fun starts
- This is why we are here today – we ***all*** have important roles to play to make it happen
- We need to make this the fight of our lives, and make sure we win it. Failure is not an option!

The future is not something that just happens to us. It is something we create. Together. Starting right now!