

Nuclear power – a global gamble

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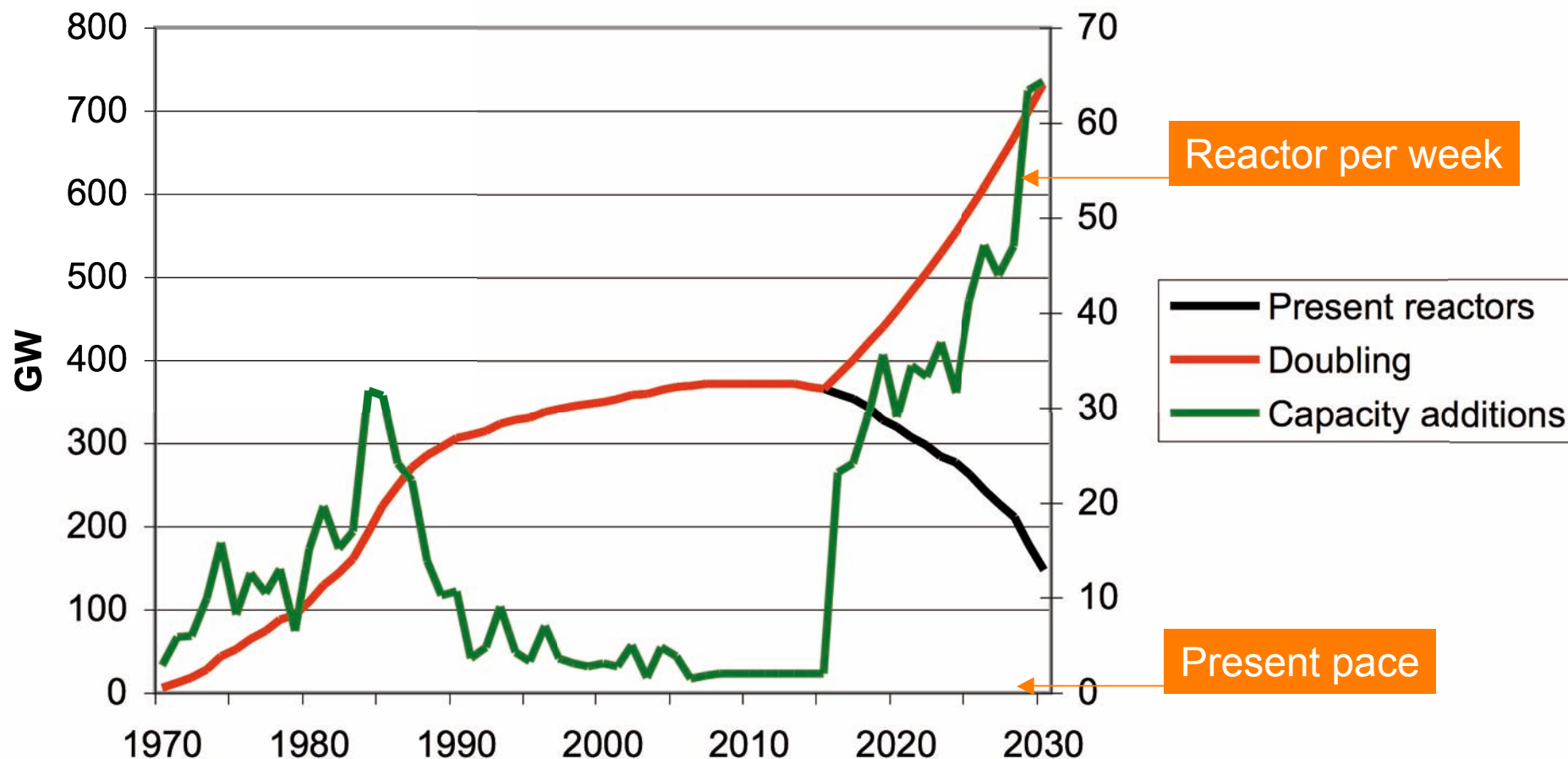
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This presentation

- Nuclear - global situation & trends
 - Nuclear's role in battling climate change
- The convenient truth – A blueprint for Energy [r]evolution
- Nuclear in Finland
 - Olkiluoto3 – the first reactor ordered to a western country in over a decade
 - New plans on the table
 - Waste management plans

The nuclear industry vision



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Would doubling the capacity reduce CO2 emissions significantly?

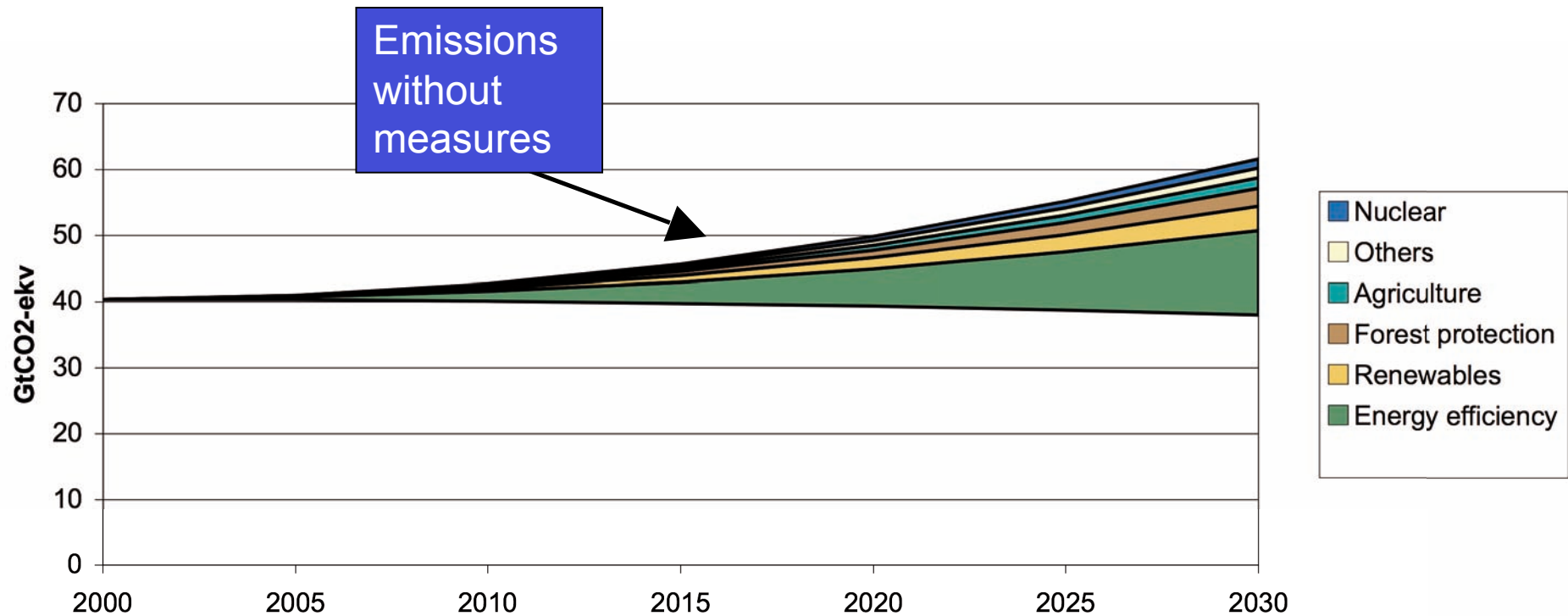
- If replaces half coal, half gas, emission reduction 1,4 GtCO₂ i.e. 3-4% from baseline
 - In reality does not replace existing plants but crowds out other investments
- ➔ Nuclear power can have, at most, a marginal role in combating climate change
- ➔ A few reactors here and there don't make a boom. Even maintaining the current capacity will be a major challenge for the nuclear industry

What if no new nukes are built?

- 3000 billion € freed up for investments in renewable energy and energy efficiency
 - Would drive down the costs of renewables rapidly
 - ➔ likely to be way cheaper by 2030

Emission reduction potentials in 2030

With a price €70/tCO₂ = 16 c/liter of gasoline



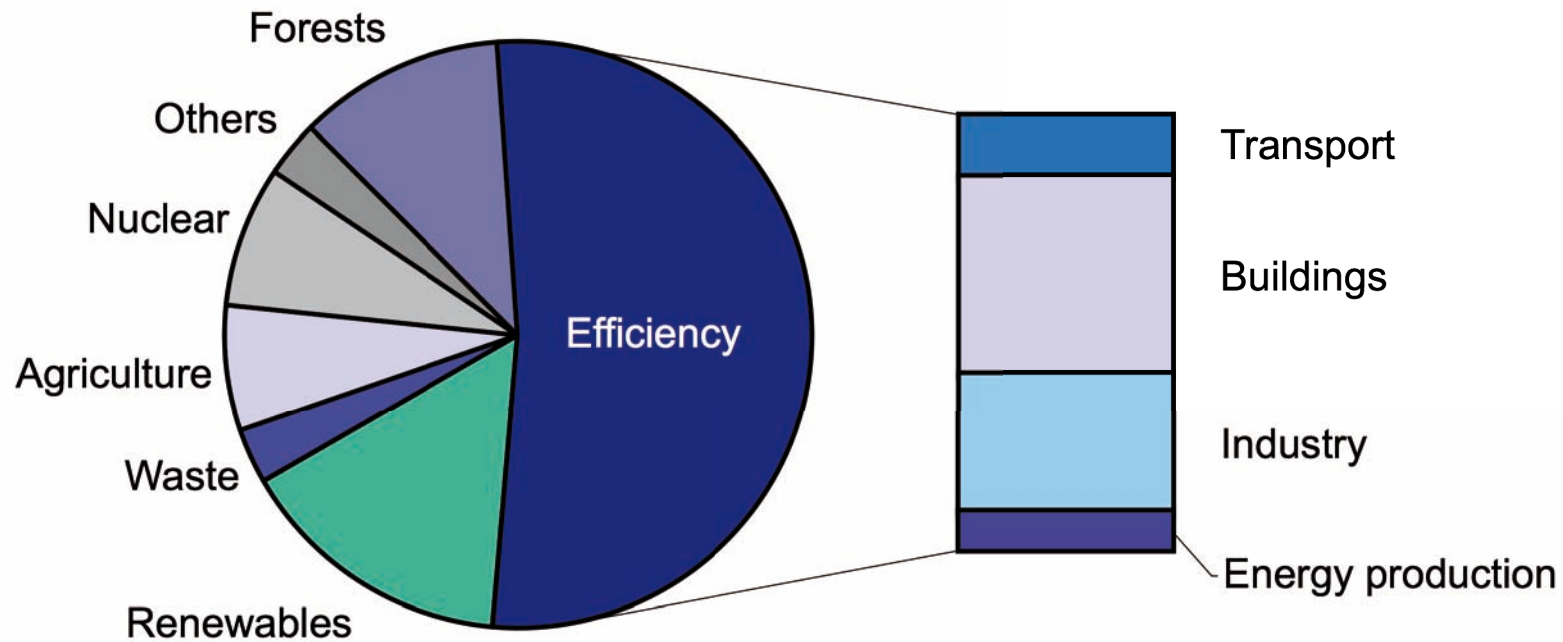
Source: IPCC

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Emission reduction potentials in 2030

With a price €70/tCO₂ = 16 c/liter of gasoline

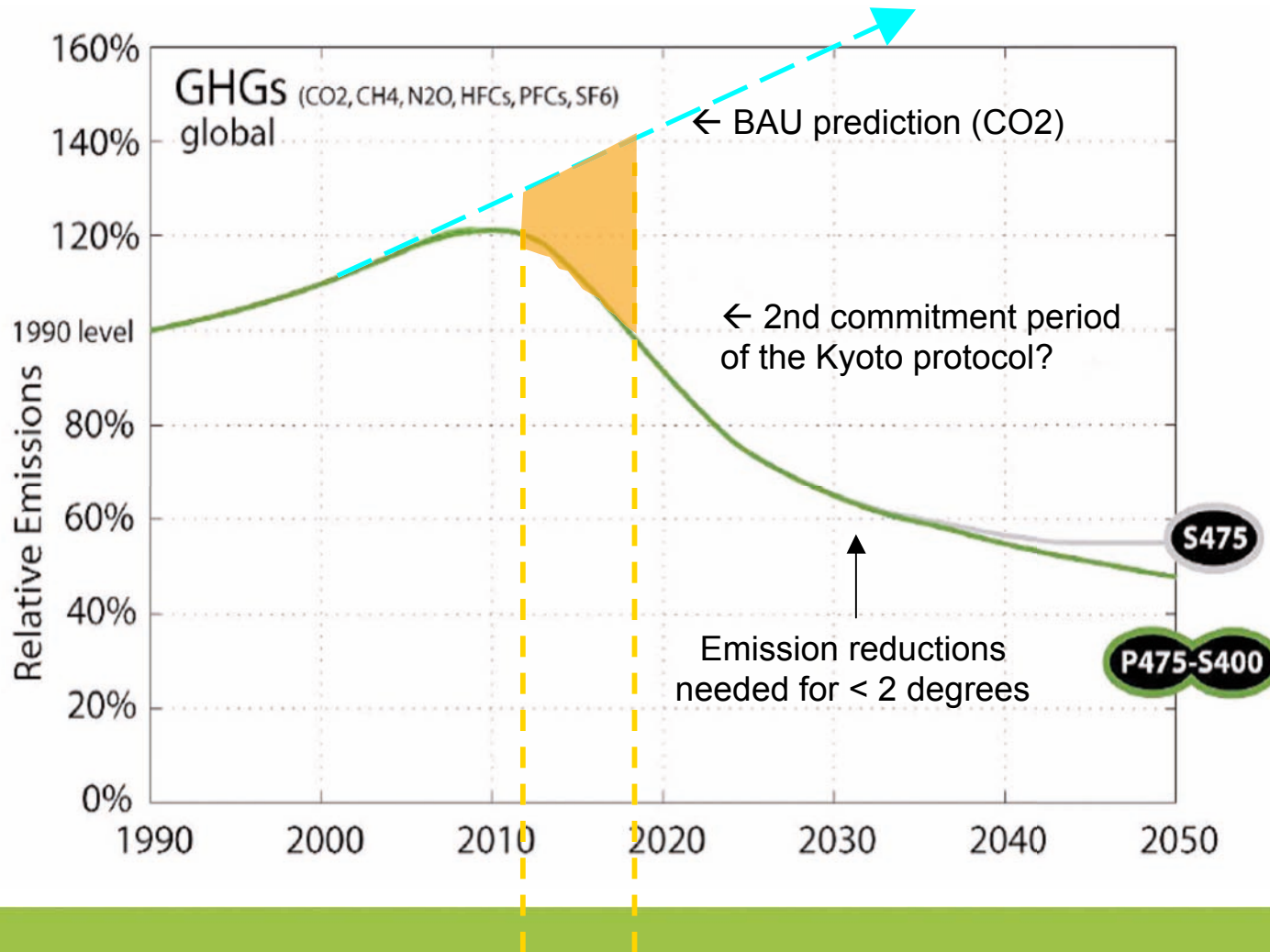


Source: IPCC

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CO2 reductions need to be greater



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Even optimistic analyses point to unsolved problems that are seen as constraints to future expansion

MIT: The Future of Nuclear Power (2003):

” To preserve the nuclear option for the future requires overcoming the four challenges described above—costs, safety, proliferation, and wastes.

These challenges will escalate if a significant number of new nuclear generating plants are built in a growing number of countries.”

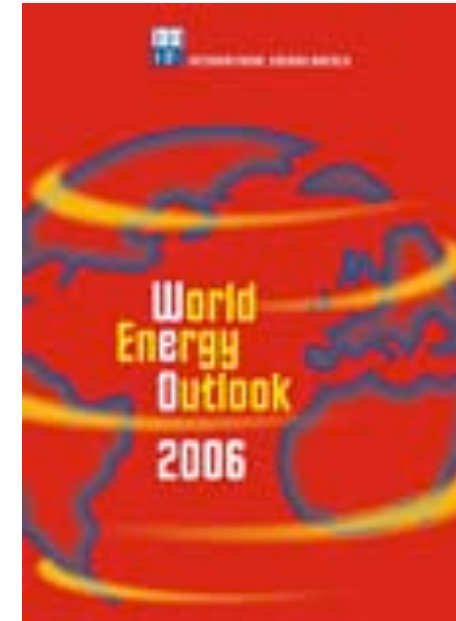


IPCC Fourth Assessment Report (2007):

” safety, weapons proliferation and waste remain as constraints.”

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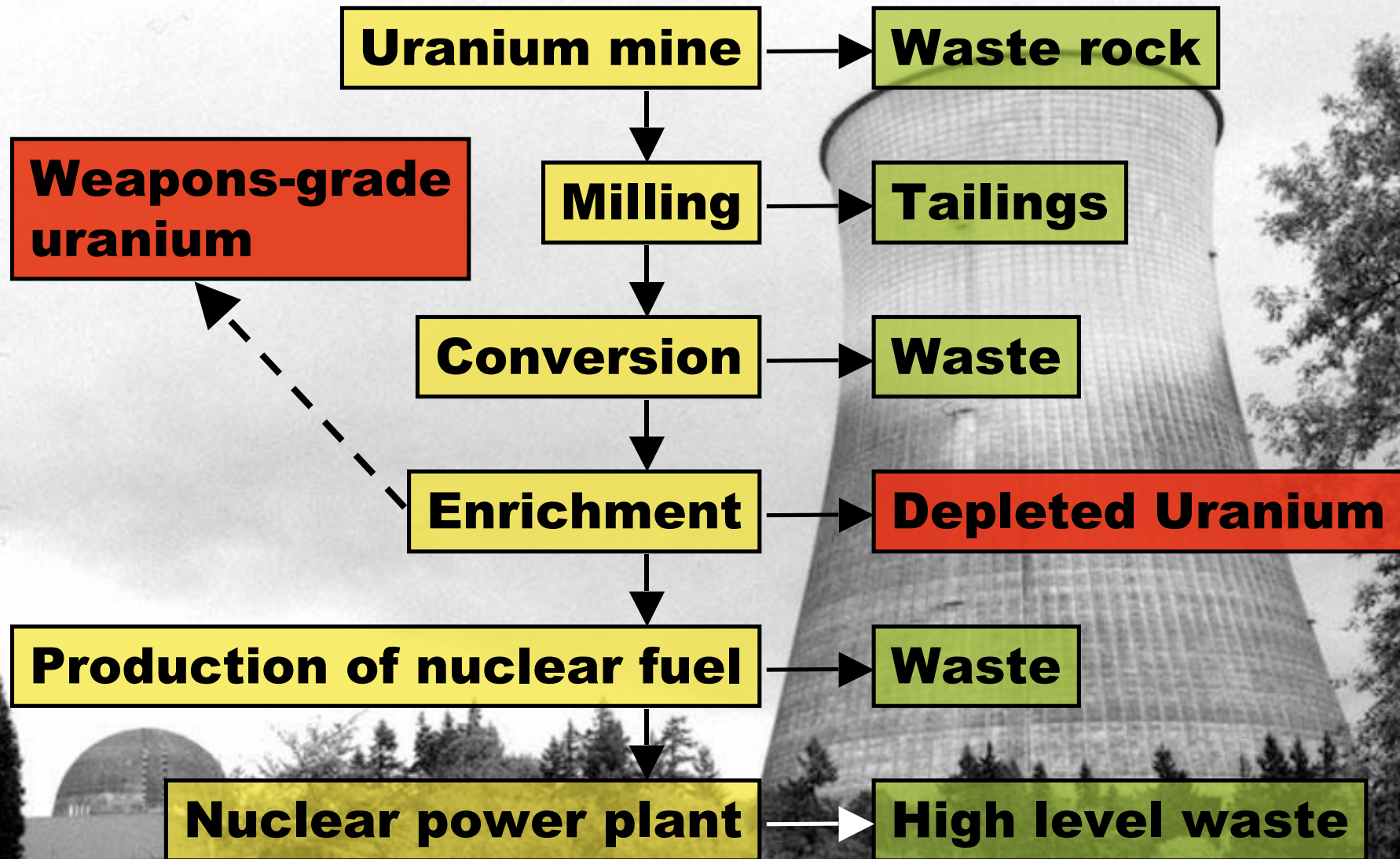
IEA: World Energy Outlook (2006):

Nuclear power can be a potentially attractive option for enhancing the security of electricity supply – **if concerns about plant safety, nuclear waste disposal and the risk of proliferation can be solved.**

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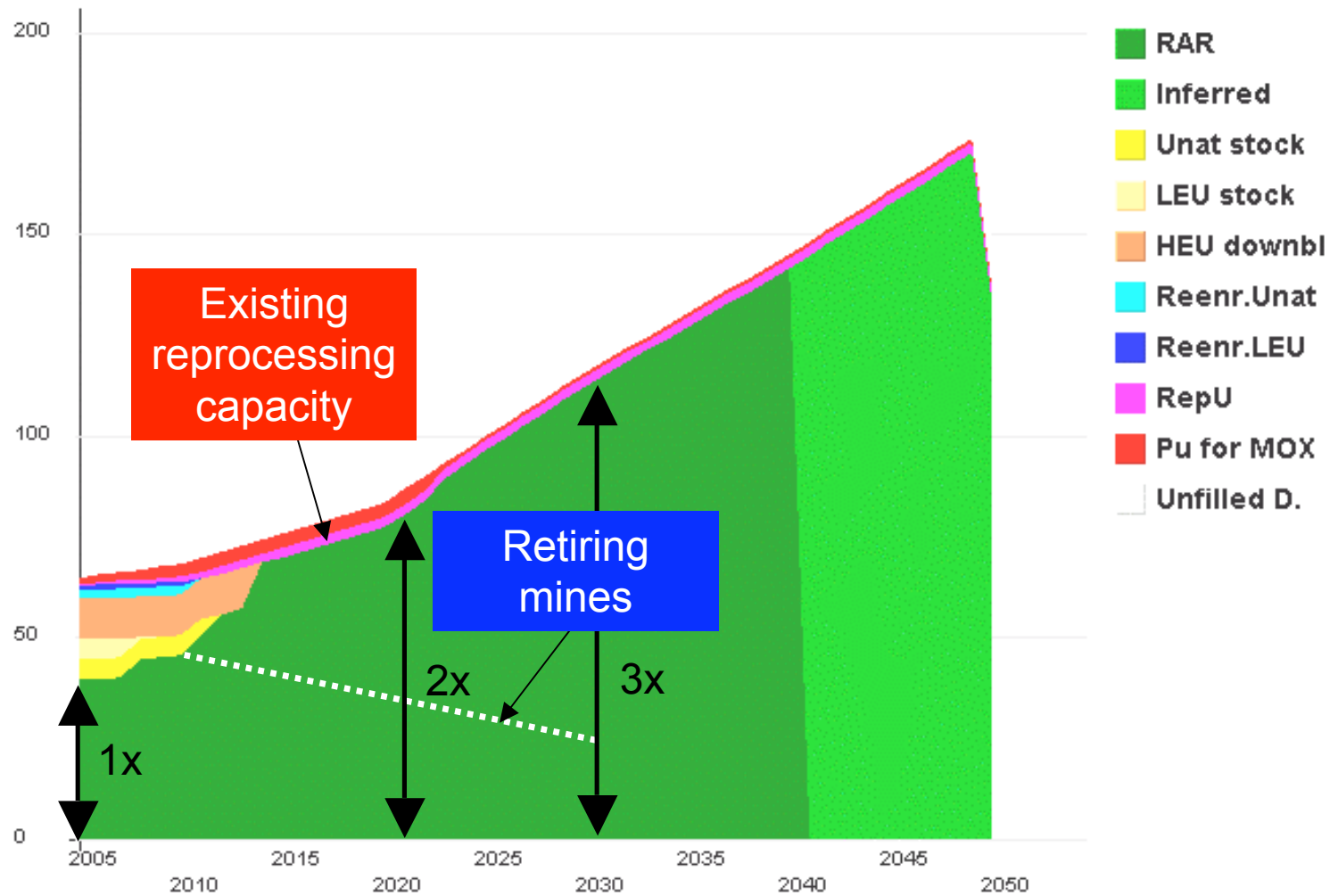
Nuclear fuel production chain



Nuclear boom: Number of reactors

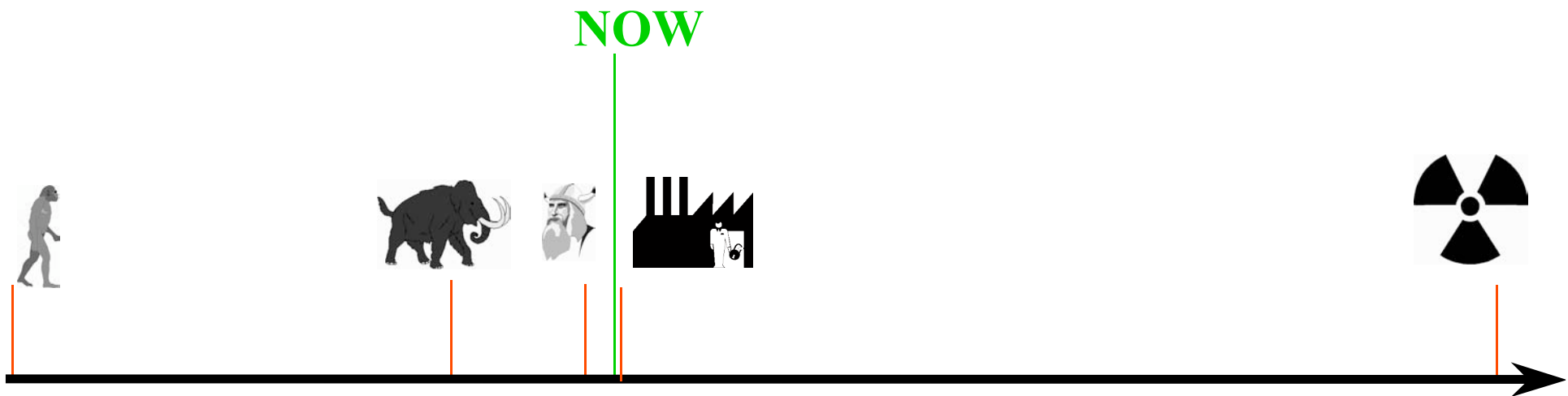
- 400-500 new plants built all over the world at a breathtaking pace
- Big expansion plans have often meant weakening safety procedures
- The ultimate amount of uranium mining and high-level waste would be tripled

Nuclear boom – uranium



Nuclear boom - New nuclear states

- To combat climate change effectively, you should build in countries where electricity consumption grows fast
 - IEA: 2/3 of the new capacity outside OECD
 - The nuclear capacity of developing countries would grow 5-fold
 - Pakistan, Indonesia, Brazil, N-Korea, Arabs...
- Earthquakes, hurricanes, weak safety culture, political instability...
- Nuclear power requires stability of society over a very large timespan!



100 000 years

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Nuclear boom - Safety culture



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Dirty bomb



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Warning over nuclear black market

Illegal networks selling nuclear technology to the highest bidder on the black market are posing a greater threat than ever, an expert has warned.

A speaker at non-proliferation talks in Washington said technology essential for enriching uranium was now freely available on the black market.

Others said that efforts to tackle the problem were tepid and in disarray.

The conference also raised concerns that the issue has receded from the non-proliferation agenda.

Crucial information

Mark Hibbs, an editor with the journal Nucleonics Week and one of the world's most prominent experts in the field, told the Carnegie Endowment for International Peace conference that barriers to nuclear technology had broken down significantly.

He said he had been able to obtain blueprints for a type of centrifuge dating from the 1960s that had taken European



Mr Hibbs obtained centrifuge blueprints on the black market

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December 08, 2005

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Keeping the World Safe from the Bomb

By Erich Follath

Mohamed ElBaradei, head of the International Atomic Energy Agency, will be awarded the Nobel Peace Prize this weekend. But in an age when nuclear proliferation is more problematic than ever, just how successful has he been in promoting peace?



AFP

The chairman of the Norwegian Nobel Committee Ole

Vienna in winter so perfectly lives up to its own clichés that it's not even surprising to hear the Strauss waltzes wafting from the windows of the city's elegant old villas. Especially when covered in snow, there is something enviable, almost provocatively peaceful, about the place.

At least that is how Vienna resident Mohamed ElBaradei sees it. And the 63-year-old head of the International Atomic Energy Agency (IAEA), is perhaps uniquely qualified to appreciate the civilized atmosphere of the Austrian capital because

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Nuclear boom - conclusions

- Are 3-4 % emission reductions worth all the risks?
- Would the money be better spent in renewables?
- Why invest on nuclear when there are safer and cleaner alternatives available?
- Few projects here and there don't make a boom.

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truth

global
energy
scenario

How to prevent dangerous climate change

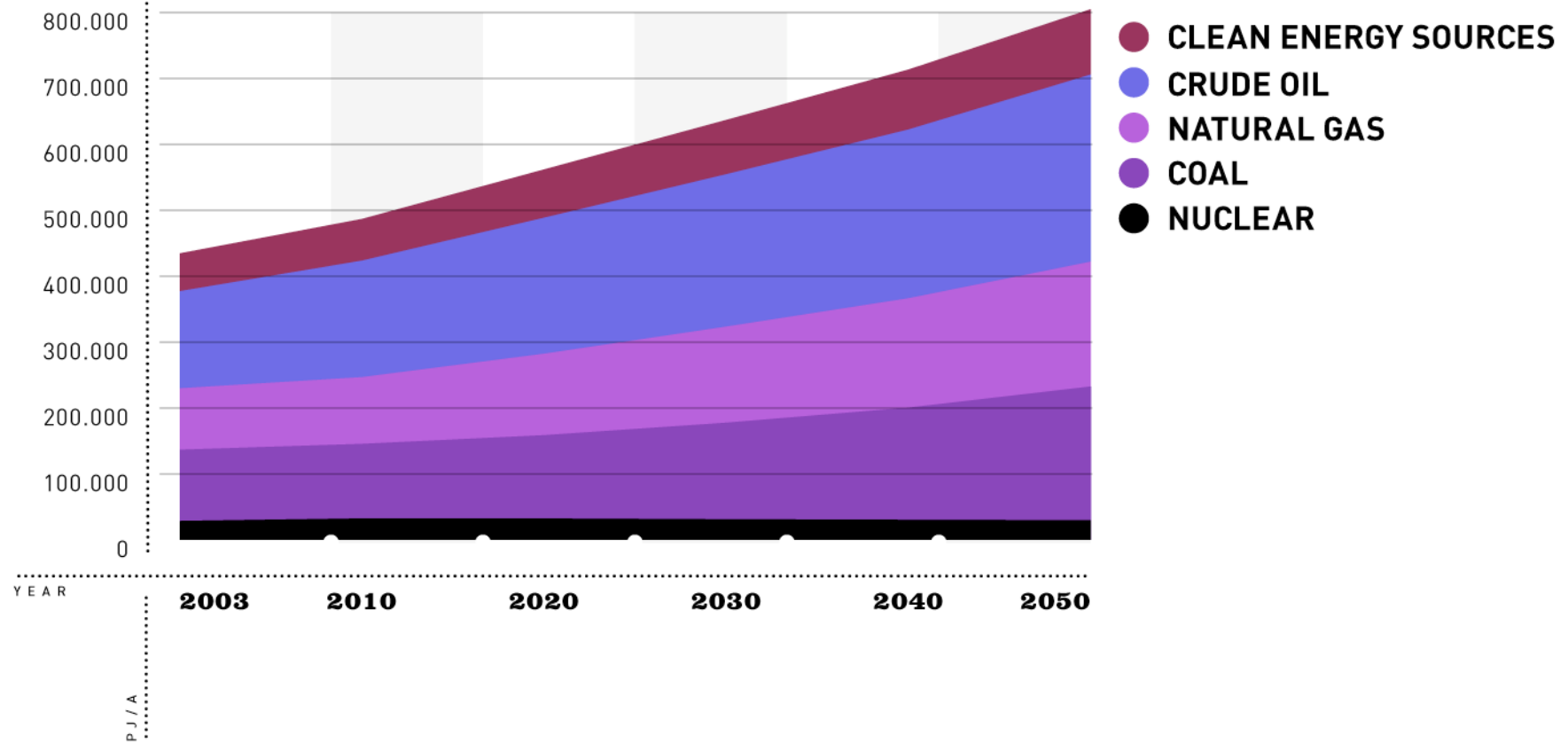


In 2020: 20% less CO₂ emissions world wide

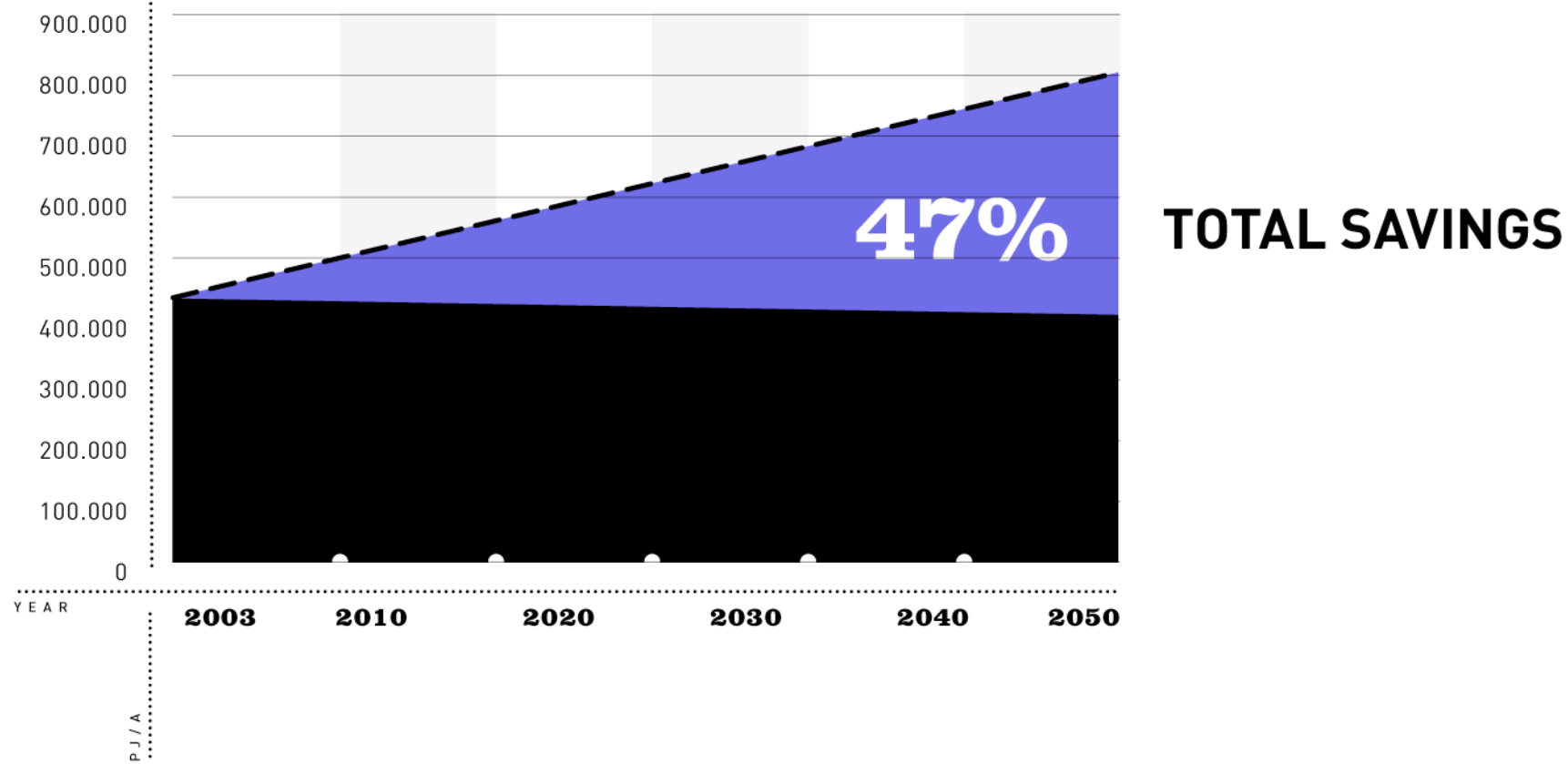
In 2050: 50% less CO₂ emissions world wide

Reference scenario

world primary energy demand

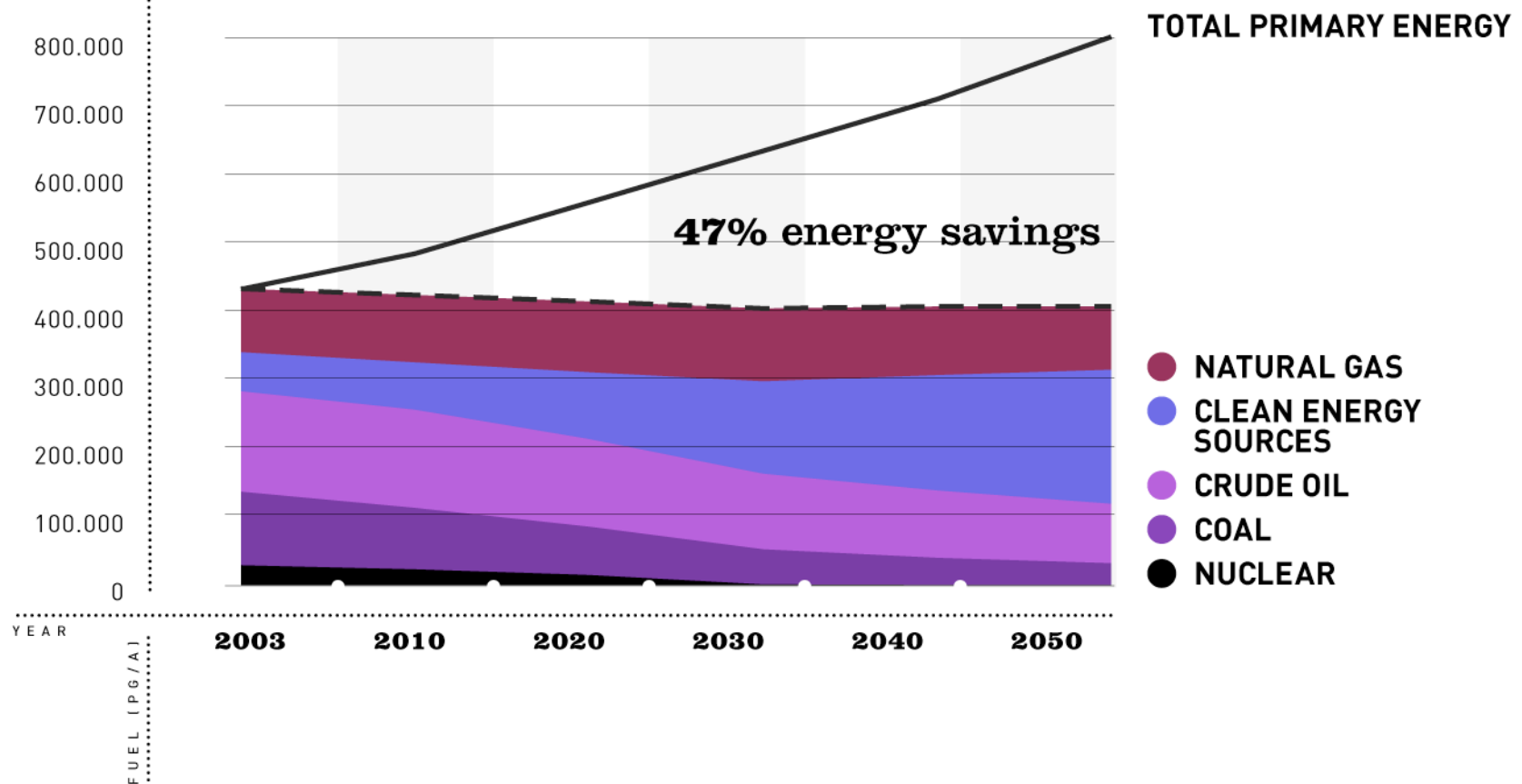


Final energy demand



primary energy demand

energy revolution



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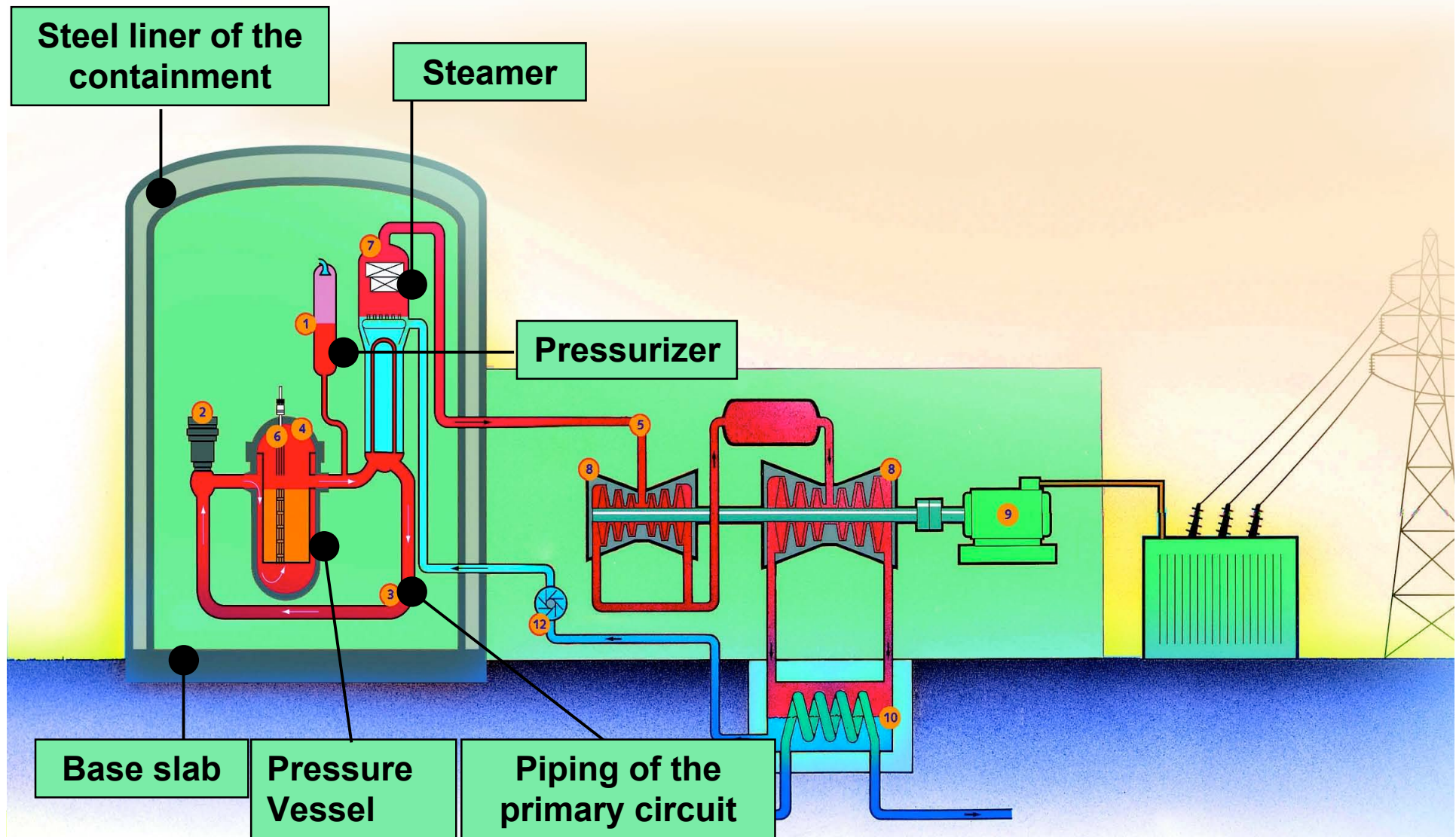
Olkiluoto3 was supposed to...

- Reduce Finland's CO2 emissions by 7,5 mio t
- Bring jobs for Finns
- Increase our energy security
- Be completely safe & high quality
- Be cheap
- Be a perfect example of good and attractive nuclear project for the rest of the world.

In reality...

- The CO2 emission reductions will be only third of what was promised.
- The majority of the jobs have gone to foreigners
- There have been a number of serious quality problems, which may cause safety risks in the operation phase.
- There have been huge cost-overruns, which proves that the original estimations were over optimistic.
- The project has NOT been a good example.

Safety faults in Olkiluoto3



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PROMISES	REALITY
Will cost 3,2 bln €, and be ready in 4,5 years. No government subsidies needed.	Current cost estimation: 5 bln, will take at least 7 years in total. Subsidies from the French government.
Will be substantially safer than the existing reactors.	Over 1500 quality violations have been reported. Some of them critical.
Will be cheapest way to achieve 7,5 mio t emission reductions.	Emission reductions will be only third of promised. Alternative based on EE & RE would have been cheaper.
Will bring a lot of jobs for Finns.	Finns got approximately 25 % of the jobs. At the same time we've missed the opportunity to create thousands of jobs in the renewables industries.

Current plans

- There are 3-4 new projects under planning
- These are not needed for meeting climate goals or future power needs, because of the targets under the EU climate & energy package.
- The motivation behind the projects is to
 - Provide the Finnish heavy industry "easily" manageable capacity with predictable price.
 - Export electricity to other Nordic countries & Central Europe.
- It is very unlikely that more than one reactor would get permits.
- Greenpeace has to make sure that the applications are disapproved by the parliament.

Nuclear waste management in Finland

- Finland has NOT solved the problem of highly radioactive nuclear waste.
 - Finland reached a political agreement in 2001 on how to move forward with the research & plans.
 - The research is now underway.
- Around 2012 Posiva is to apply for a construction permit - the safety of the plans will be assessed.
- Around 2020 Posiva is to apply for an operational permit.
- Some questions may remain unanswered forever.

MOST DANGEROUS SUBSTANCES ON EARTH

- Finnish used nuclear fuel is going to contain 40 000 kg plutonium



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- **Together 4000 tons of used nuclear fuel is planned to be contained in 1500 canisters**



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AN EVERLASTING PROBLEM

- Nuclear waste continues to be dangerous hundreds of thousands of years.



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AN EVERLASTING PROBLEM

- The half-life of plutonium is 24 000 years



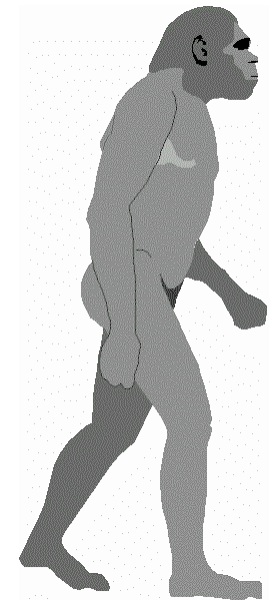
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AN EVERLASTING PROBLEM

- 50 000 years ago
the Neanderthals lived in Europe

NOW



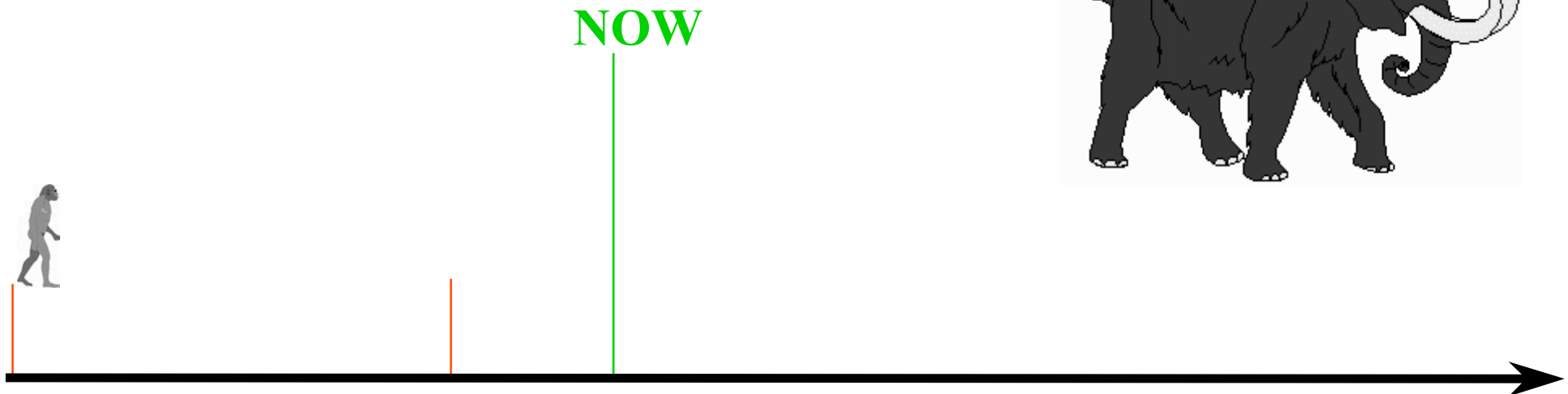
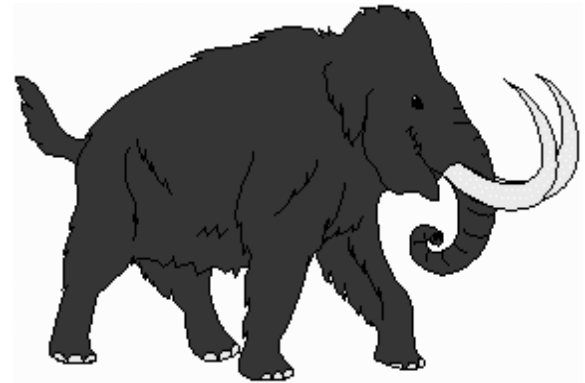
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AN EVERLASTING PROBLEM

- 10 000 years ago the last ice-age covered Europe in ice.

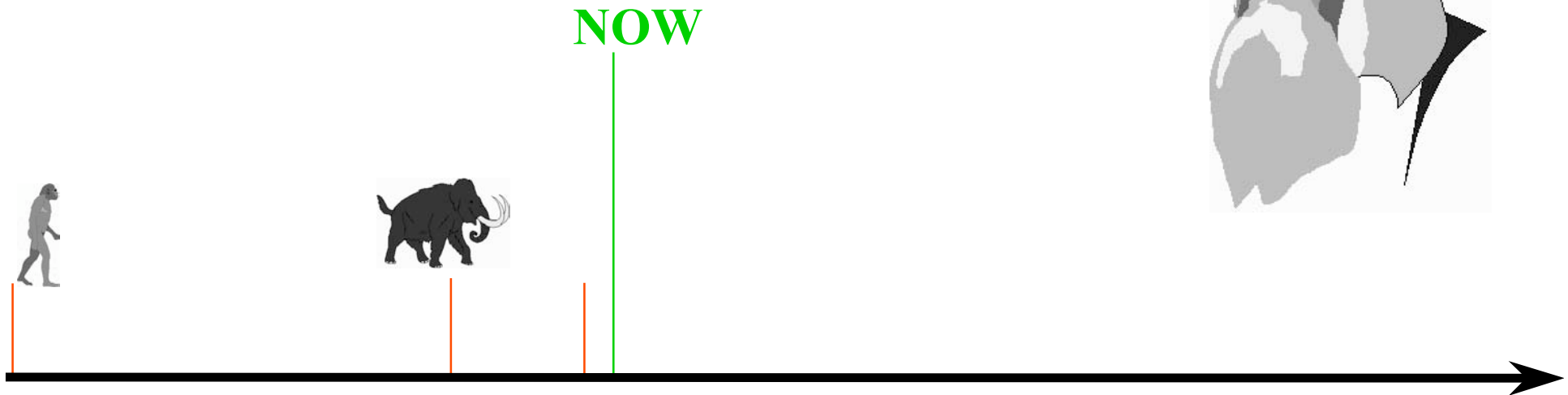


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AN EVERLASTING PROBLEM

- About 1 000 years ago the Vikings sailed on shores of Europe

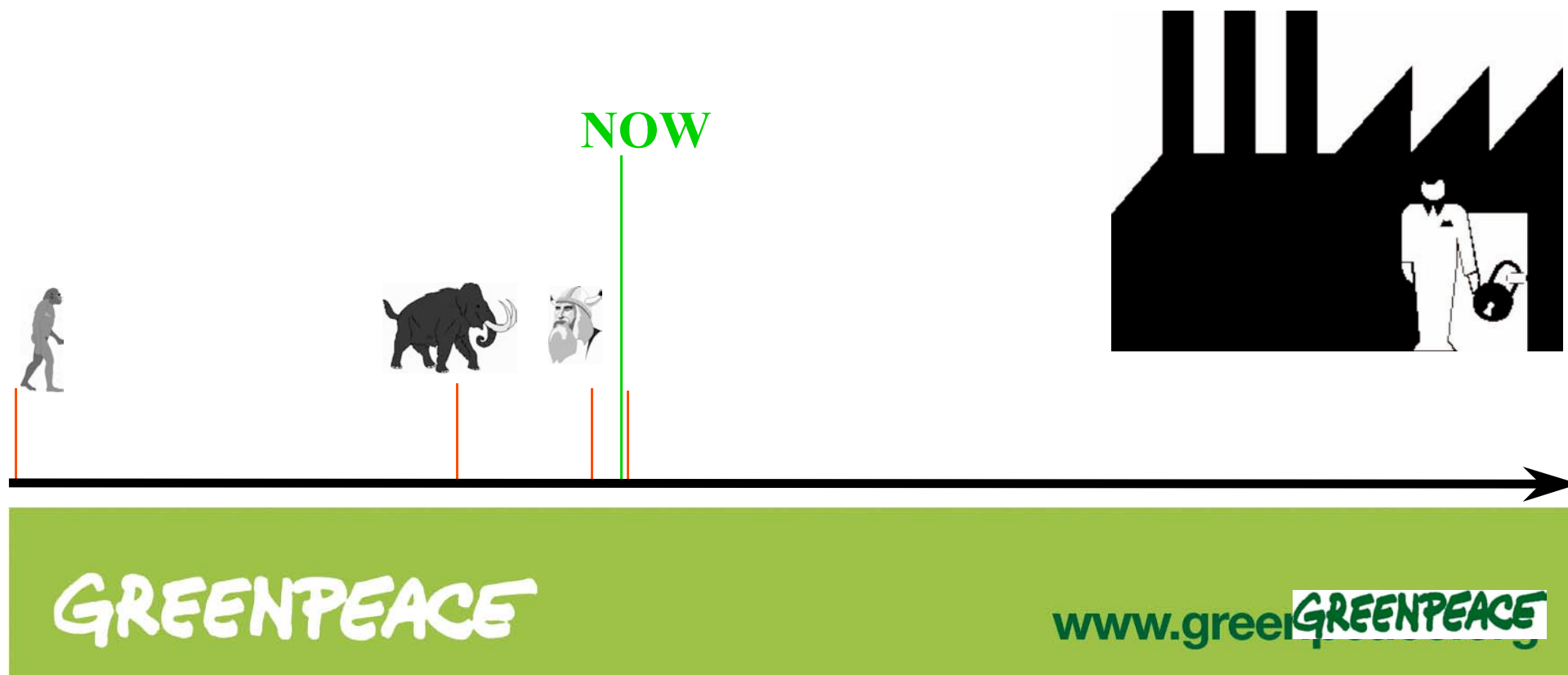


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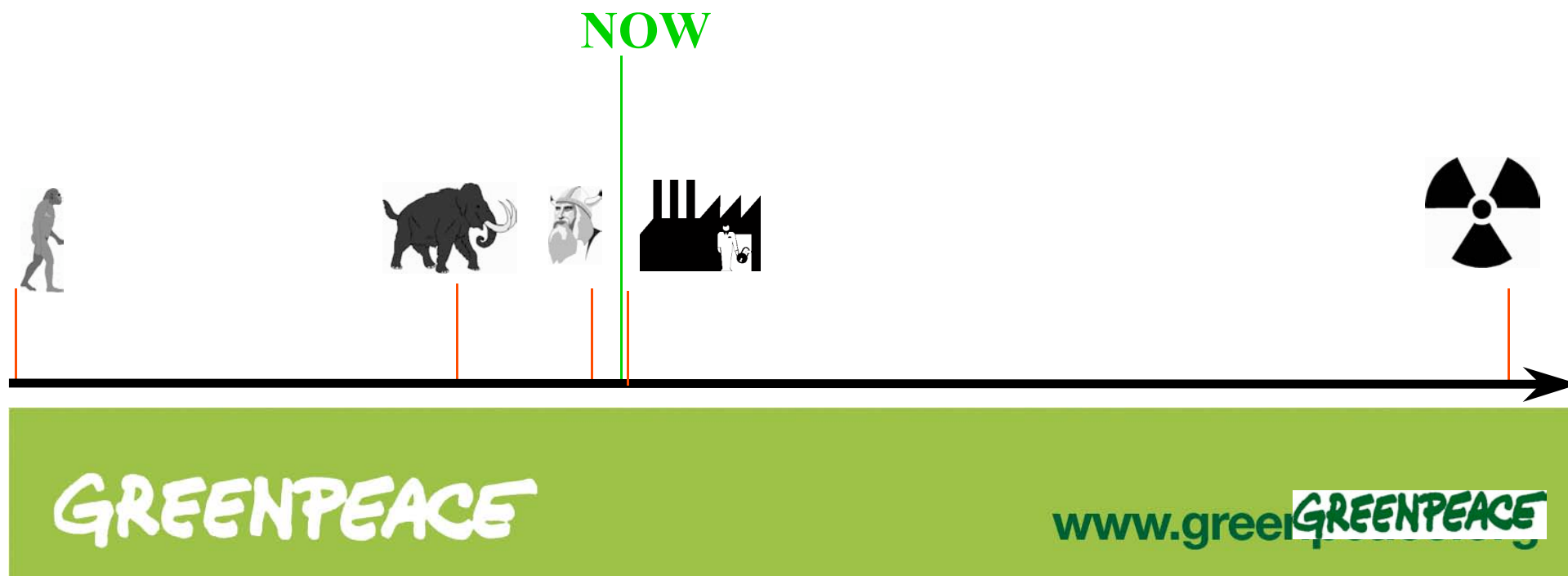
AN EVERLASTING PROBLEM

- Year 2030 nuclear waste production is stopped in Finland



AN EVERLASTING PROBLEM

- Year 100 000. Nuclear waste still dangerously radioactive

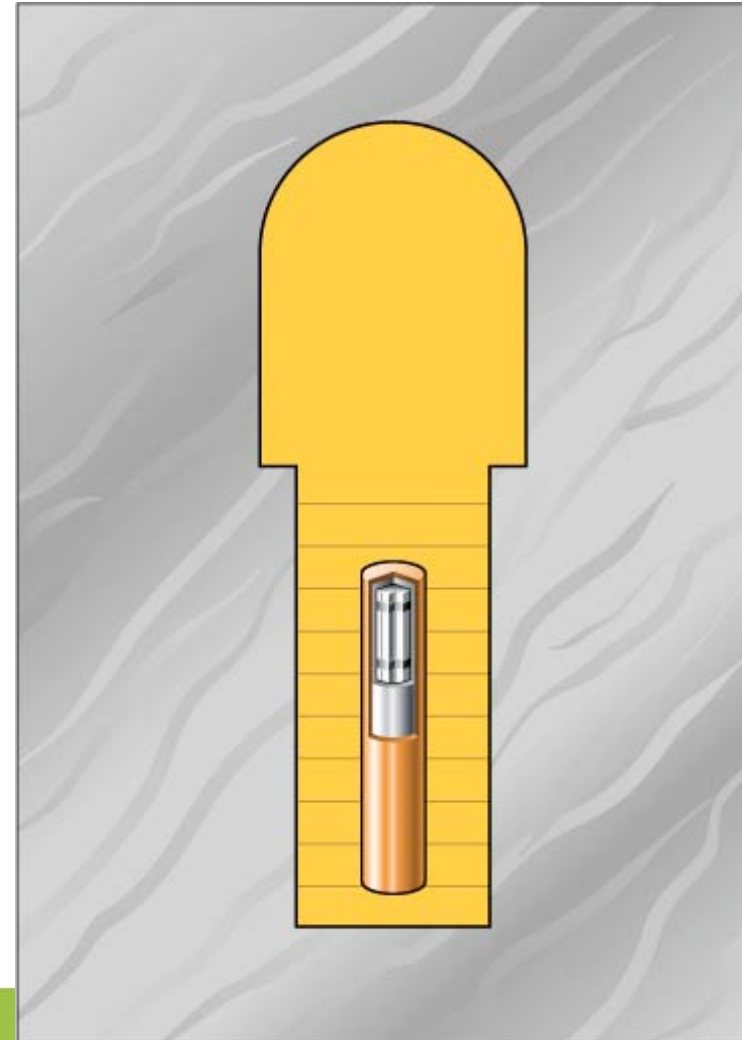


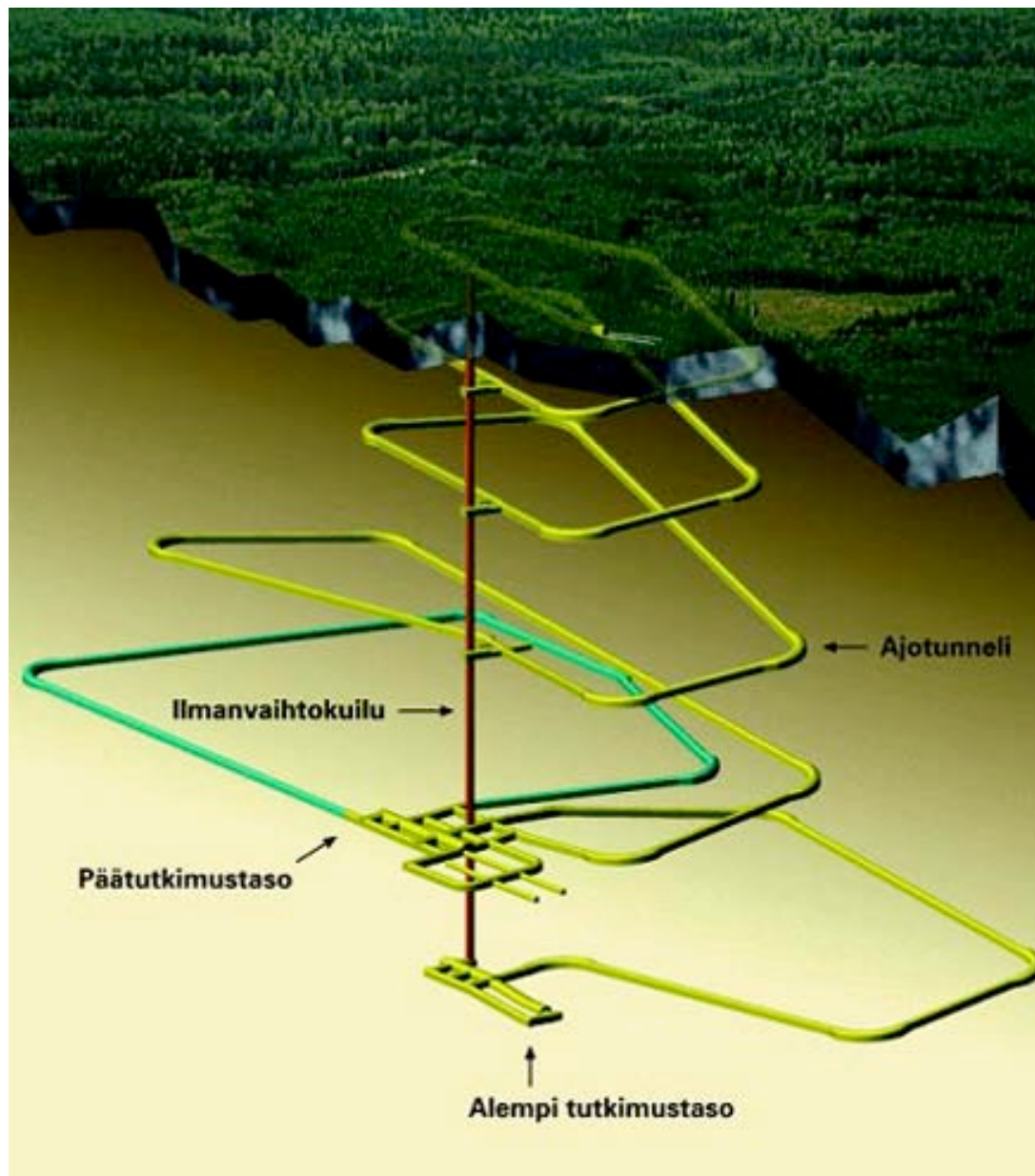
The ultimate moral test

- Easiest moral problems involve immediate and certain outcomes
- Here we have an
 - enormous time span (even compared to climate change)
 - and major uncertainties

THE BARRIERS

- According to Posiva plans nuclear waste will be buried 500 meters into the ground, where radioactive substances will be isolated from the environment with different barriers



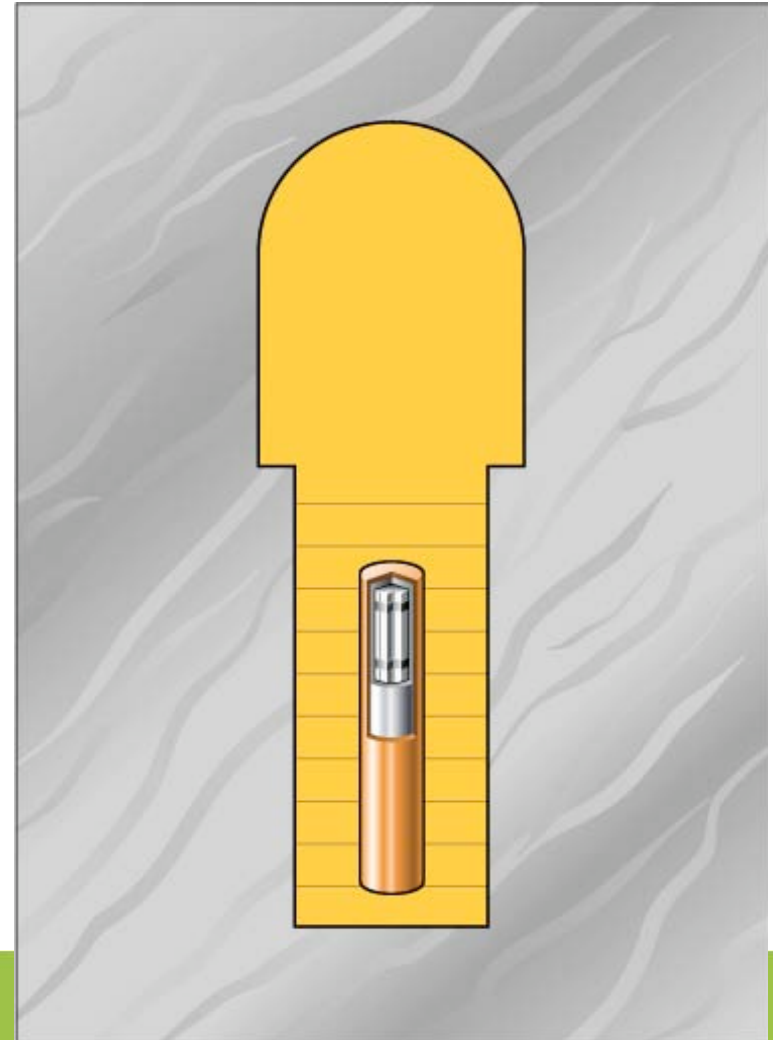


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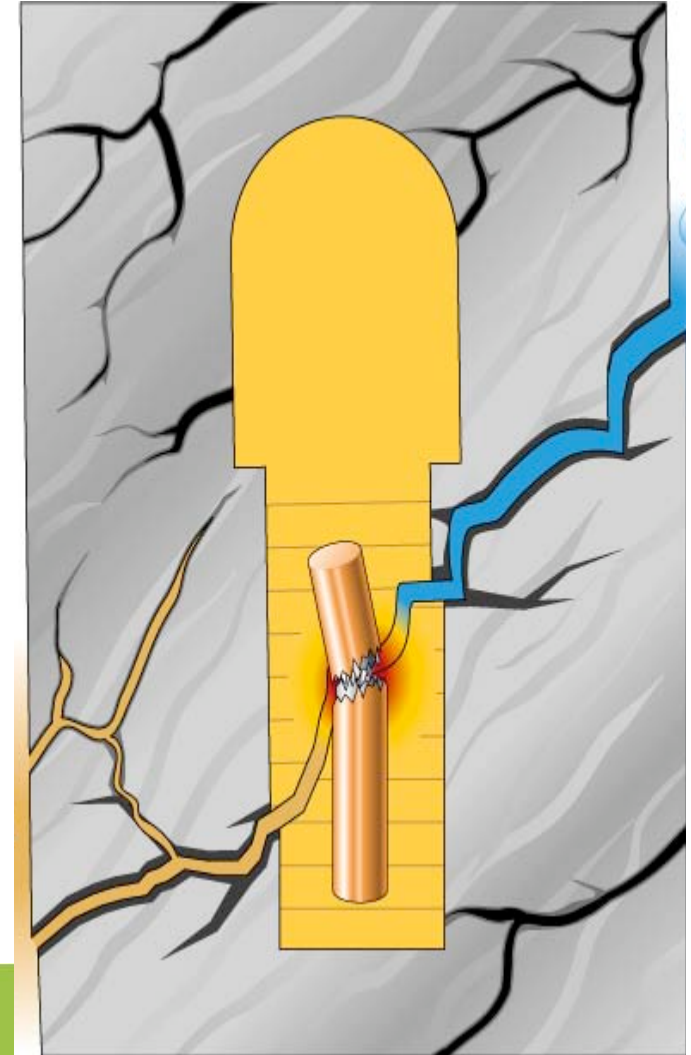
A COMMON CAUSE

- Multi-barrier system:
 - Bedrock
 - Bentonite
 - Copper/steel canister
 - Nuclear fuel
- Common cause: “Even if one barrier is destroyed rest of the barriers can stop leakage of radioactive substances”



...but will it work?

- It is not certain that rest of the barriers will shield the fuel if one barrier fails.
- The results of POSIVA's research can be summarised:
 - **There is a chance that there will be no catastrophe**



A PRINCIPLE - AMBITION

- Nuclear waste shall be handled so that it will not be a burden for the future generations or impose a risk to them



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Reality

- The waste will remain dangerous for longer than we can comprehend
- No liability once dump is sealed
- No plans or funds for retrieval
- Waste fund raised by tax on power could prove insufficient



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FINNISH SOLUTION?

- Decisions before research.
- Shortest testing programme in the world?
- Small group of experts, very limited public discussion.
 - International experts have criticized the plans e.g. for too much haste



And the rest of the gang?

- Sweden: Oskarhamn/Forsmark 2018?
- France: Bure 2025?
- US: Yucca 2017?
- Germany, Canada, Japan by 2035?
- Russia, Indonesia, China...

HUMAN INTRUSION

In addition to natural damage large radioactive emissions can be caused by human intrusion. This can happen unintentionally or intentionally.

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HUMAN INTRUSION

- We have not found all the burial sites of the Viking times (800 e.kr)



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HUMAN INTRUCION

It is not credible that knowledge of the storage site could be passed on for 100 000 years.



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HUMAN INTRUSION

Our descendants can unintentionally hit in the storage when they are exploring for minerals or water and release radioactive materials



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HUMAN INTRUSION

Storage will contain large amounts of steel and copper which can interest our descendants to excavate the storage site.



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HUMAN INTRUSION

- Storage is going to contain amounts of plutonium, material for building a nuclear bomb



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HUMAN INTRUSION

- According to the international nuclear safety organisation IAEA the storage will become a “plutonium grave” which has to be guarded even after storage is ready



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HUMAN INTRUCION

- How can we communicate the danger to the future generations?



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HUMAN INTRUCION

- How long can we sustain guarding?
- How can we develop a guard scheme for 100 000 years?
- Who will pay for the guarding?



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WHAT CAN WE DO?

- Continue seek for solutions
- Store waste
 - In an interim storage
 - guarded
 - reachable



Conclusions

- Nuclear is inherently problematic as energy source
- With nuclear you have to just assume and trust too much – without really knowing. Undemocracy is the prerequisite.
- Nuclear is not needed for combating climate change. On the other hand, it may delay the "renewable energy revolution".
- Who will the public trust?

Thank you!

For further information, please contact:

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Or visit: www.olkiluoto.info and www.greenpeace.org

The Greenpeace logo, featuring the word "GREENPEACE" in a bold, white, sans-serif font with a slightly distressed or hand-painted appearance, set against a solid green background.

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