Introduction to Climate Change, Energy & ICTs

ICT & Climate Change Training Program

Session 1

ITU and climate change

ITU ACADEMY

Session Objectives

This session provides an overview of climate change, its impact, its causes and what we are doing about it.

It explains how energy is generated and consumed with best practices from various countries.

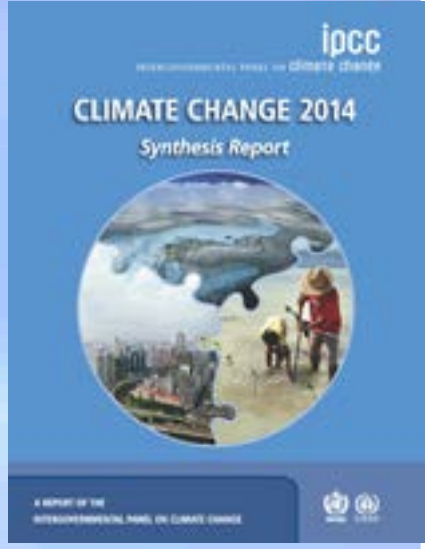
Finally it introduces ICTs and the role that policy makers and regulators can play in tackling climate change.

STUDENTS

Session Topics

- Why should we care about Climate Change and Energy Saving?
- The evidence for Climate Change and the link to human activities.
- Energy: where is comes from and where it goes.
- What are ICTs?
- The role of ICTs in tackling climate change.
- Introduction to the role of policy makers and regulators in tackling climate change.

IPCC 5th Assessment Report



SPM 1.1 Observed changes in the climate system

- Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen.
- Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850.

Source: IPCC 5th Assessment Report: "Climate Change 2014 Synthesis Report Summary for Policymakers" www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

Scientific Factors

Internal variability

External factors

Natural

Anthropogenic

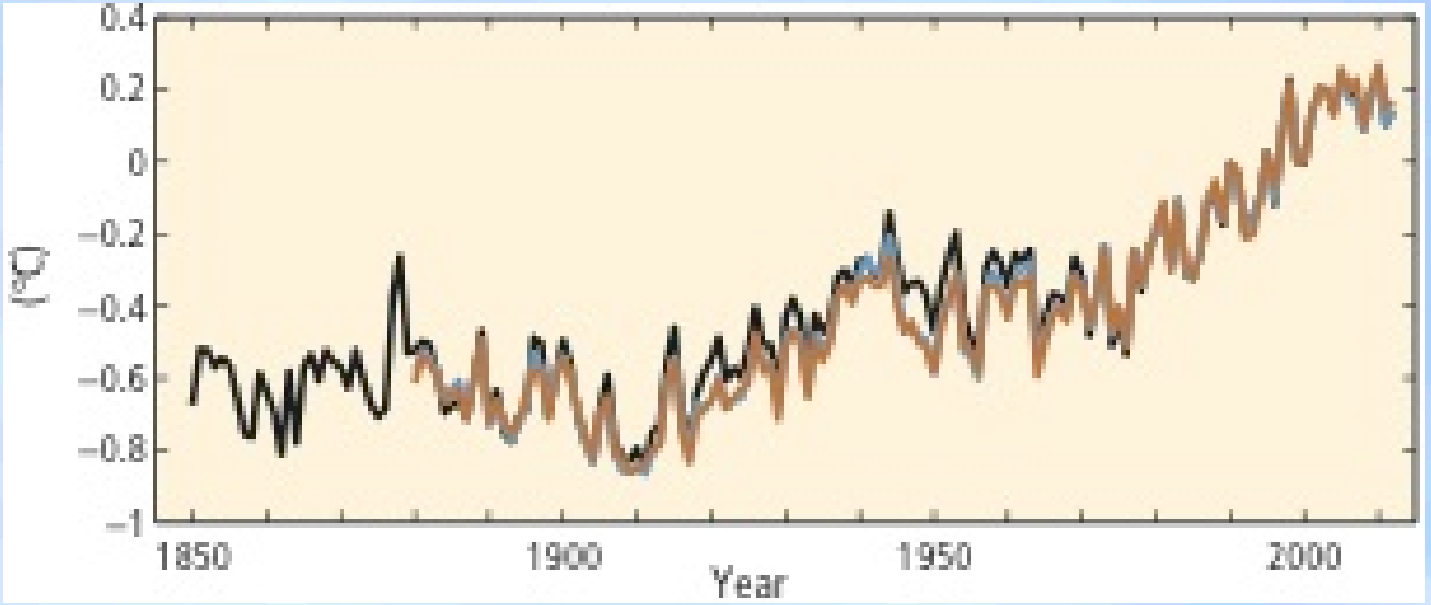
The scientific factors whose convergence is giving rise to global warming are as follows[7]:

1. Air temperatures are increasing. Since 1970, satellite measurements have been added to those taken by ground-based meteorological stations, enabling seamless coverage of the entire planet.
2. The oceans are warming up. Since the 1980s, the surface temperatures of the oceans have been regularly measured by satellites, in addition to which several hundred drifting buoys have been deployed in all the world's seas. Temperature profiles down to depths of 2000m are periodically effected to determine the temperature and salinity of the entire water column.
3. Mountain ice is receding, it being a well-known fact that mountain glaciers enable researchers to conduct lengthy series of measurements.
4. The polar ice caps are sliding more rapidly towards the sea. Greenland and the Antarctic are between them reported to have been shrinking by some 500 billion tons of ice per year over the past ten years or so, with the annual loss increasing by some 36 billion tons.
5. The sea level is rising. Sea-level gauges have revealed an annual 1.6 to 1.8 mm rise in sea level during the last century. Since the 1990s, altimetry satellites have been in use, showing that from 1993 to 2010, the oceans have been rising by an average 3.3 mm per year, i.e. twice as rapidly as the rise recorded by sea-level gauges during the twentieth century. This acceleration is confirmed by recent measurements using sea-level gauges.
6. Sea ice is disappearing. Since 1978, satellites have detected a reduction in the ice coverage of the Arctic Ocean, from 8 million km^2 in 1980 to 4.33 million km^2 in 2011.
7. In the northern hemisphere, terrestrial species are moving northwards.
8. The permafrost is warming.

Source: ITU-D SG 2 REPORT QUESTION 24/2 ICT AND CLIMATE CHANGE

The Evidence for Climate Change (1)

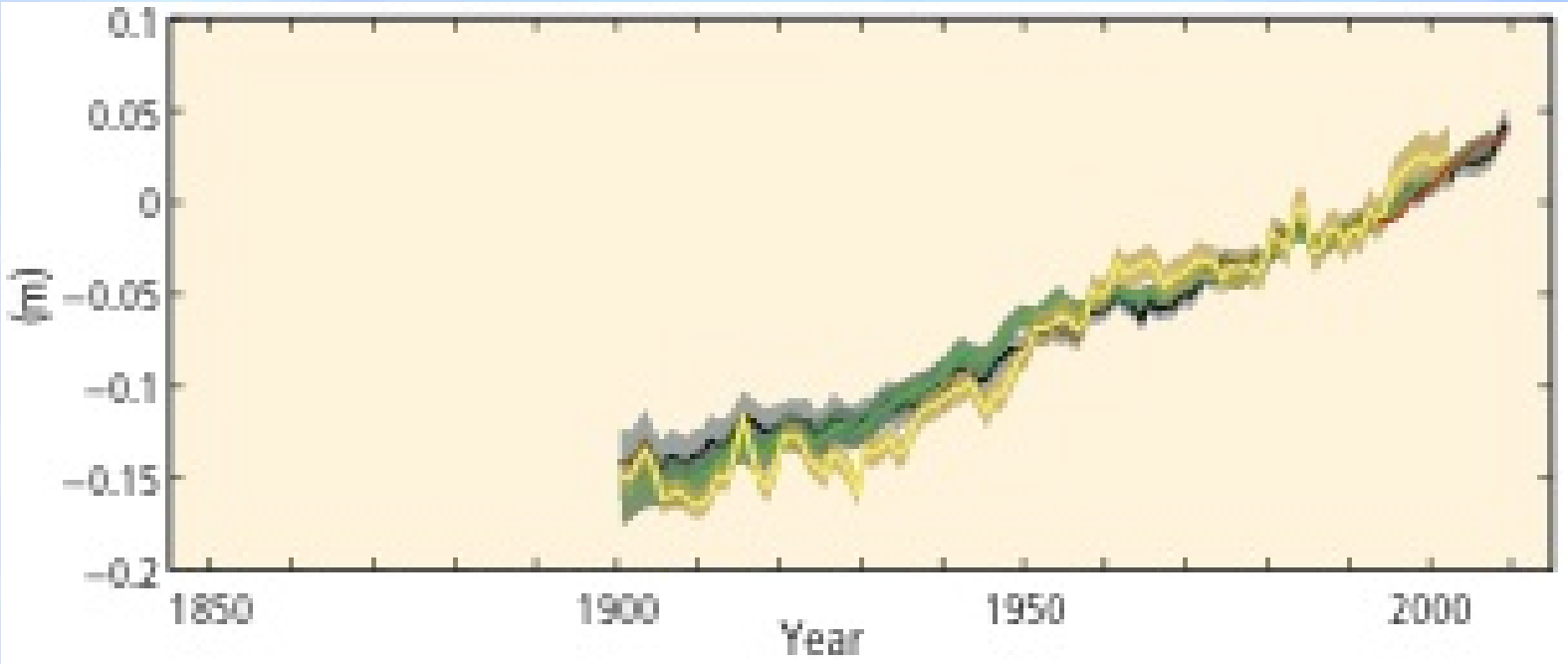
- Globally averaged combined land and ocean surface temperature.



Source: IPCC 5th Assessment Report: "Climate Change 2014 Synthesis Report Summary for Policymakers" www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

The Evidence for Climate Change (2)

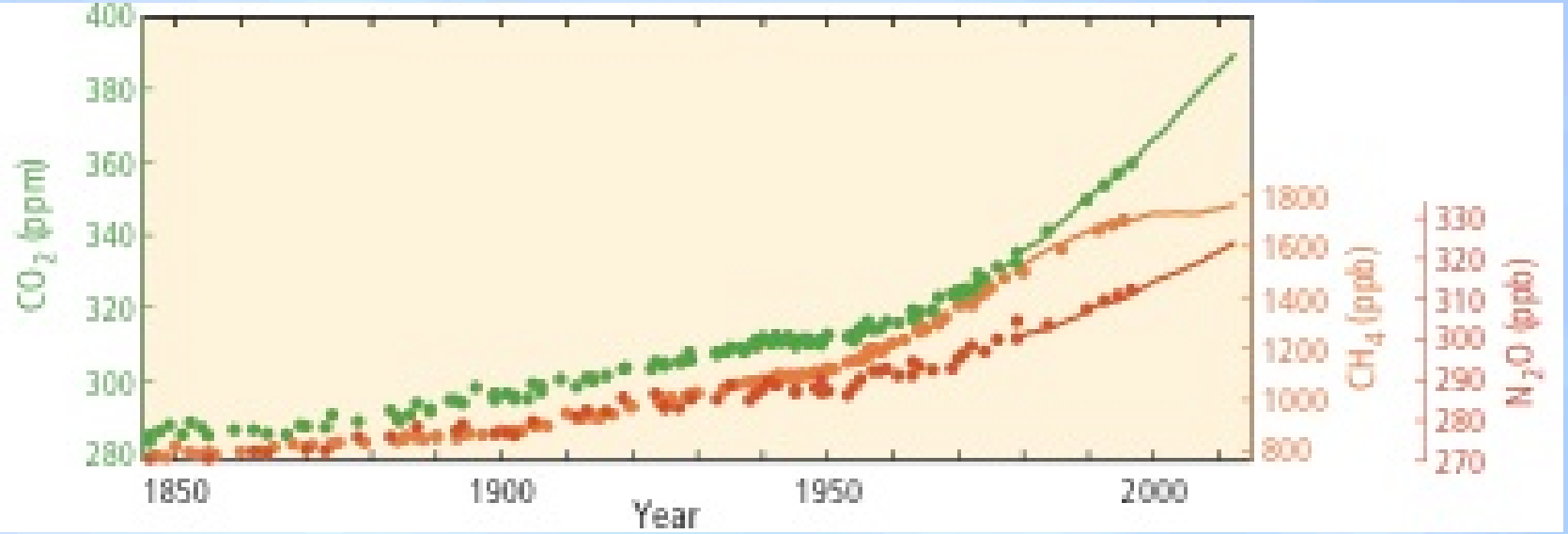
- Globally averaged sea level change.



Source: IPCC 5th Assessment Report: "Climate Change 2014 Synthesis Report Summary for Policymakers" www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

The Evidence for Climate Change (3)

- Globally averaged greenhouse gas concentrations.

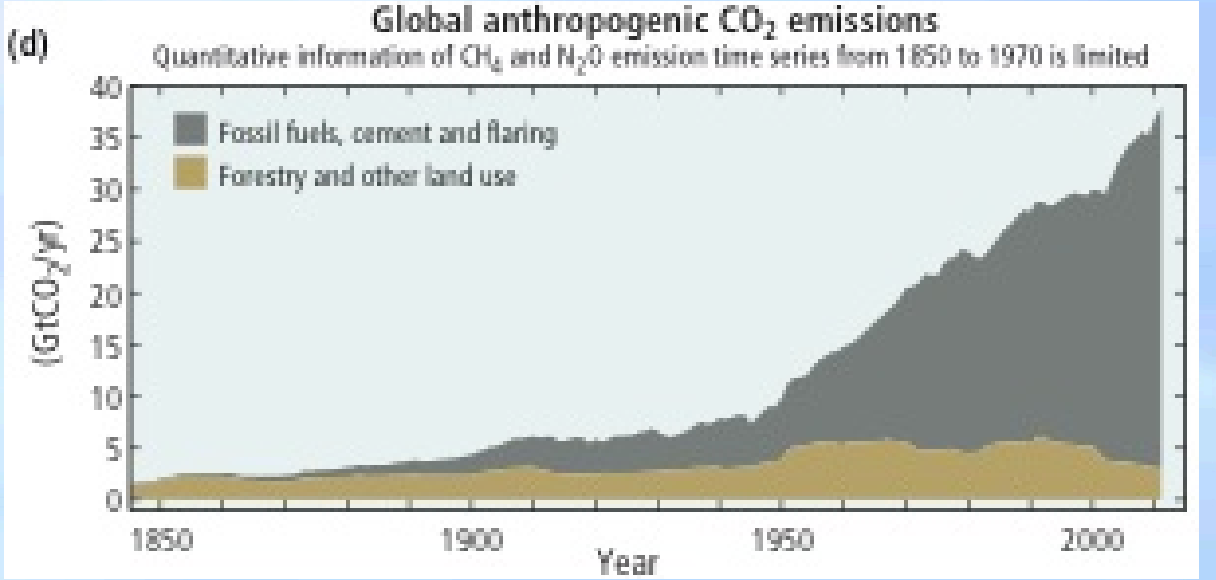


Source: IPCC 5th Assessment Report: "Climate Change 2014 Synthesis Report Summary for Policymakers" www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

Human Influence on the Climate

SPM 1. Observed Changes and their Causes

- Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems.



Local Impacts of Climate Change (Example: Pakistan)

- Excessive flooding from increased river flows (especially in 2010 and 2011).
- Droughts (especially in 2010).
- Rapid glacial melting threatening cases of Glacial Lake Outbursts (GLOFs).
- Threats to coastal areas due to projected sea level rise, and increased cyclonic activity due to higher sea surface temperatures.
- Further decrease in (already scanty) forest cover.
- Increase in incidence of dengue fever.

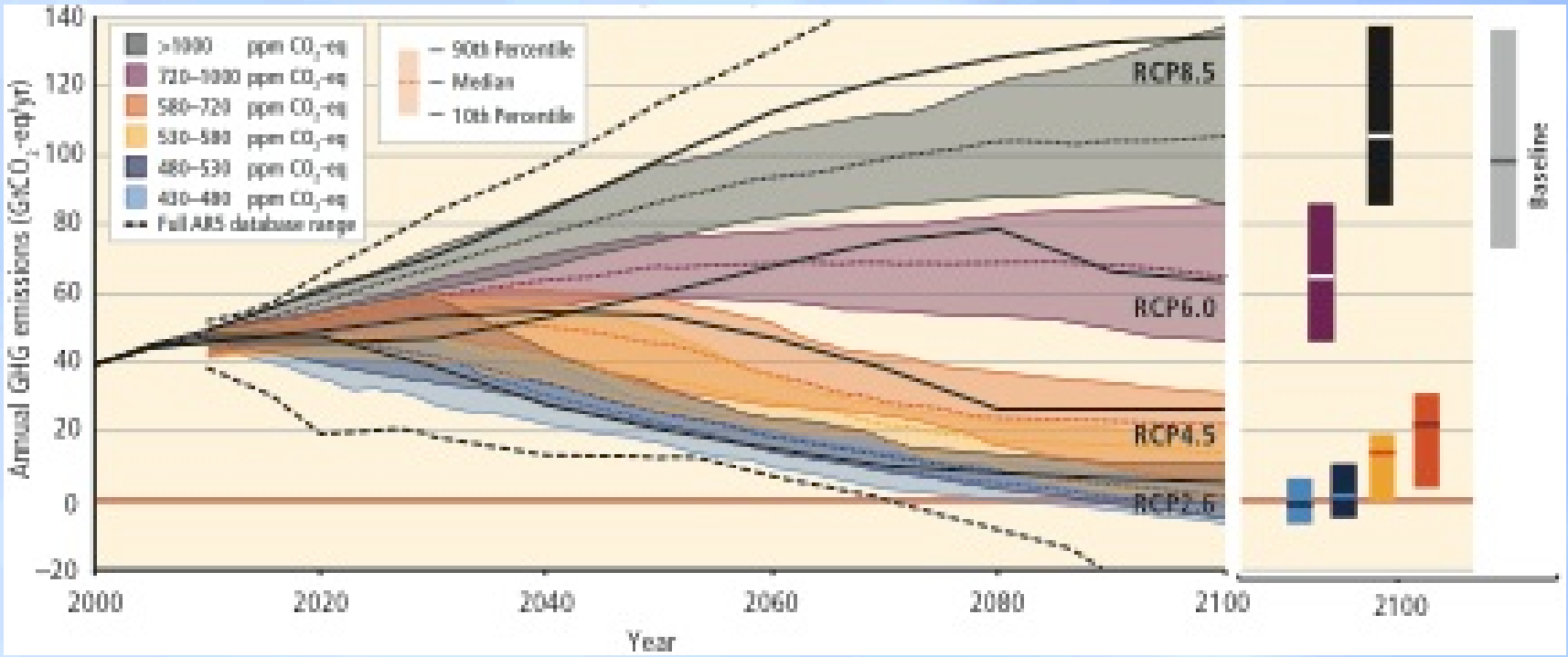
Source: Statement by Mr. Muhammed Javed Malik, Secretary (National Disaster Management), Government of Pakistan, at the High Level Segment of 17th Conference of the Parties to UNFCCC, Durban, South Africa, 8 December 2011.

The cost of Climate Change

- Impacts will cost Pakistan an estimated US$6-14bn per year in period up to 2050.
- Therefore, it is highly desirable to reduce frequency and intensity of natural disasters,
- …but levels of GHGs in the atmosphere are a global phenomenon and can only be reduced through concerted action in conjunction with other countries.
- Therefore, a National Adaptation Plan (NAP) is needed for all countries in order to minimise predicted impacts of climate change on people and populations.
- Switching to a low-carbon energy system now could save $1.8trn globally by 2040 [1].

[1] Citibank: Energy Darwinism II: Why a Low Carbon Future Doesn't Have to Cost the Earth

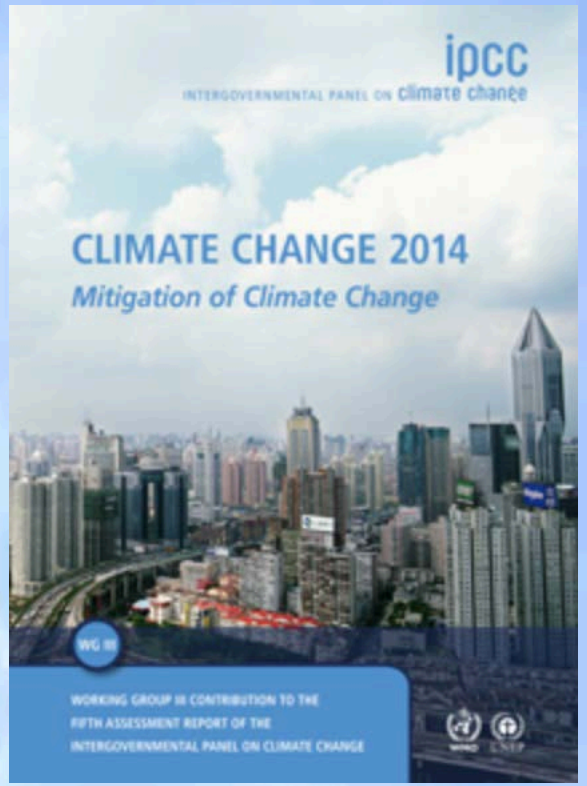
Possible GHG emission pathways 2000-2100…



Warming will continue beyond 2100 under all RCP (Representative Concentration Pathway) scenarios except RCP2.6.

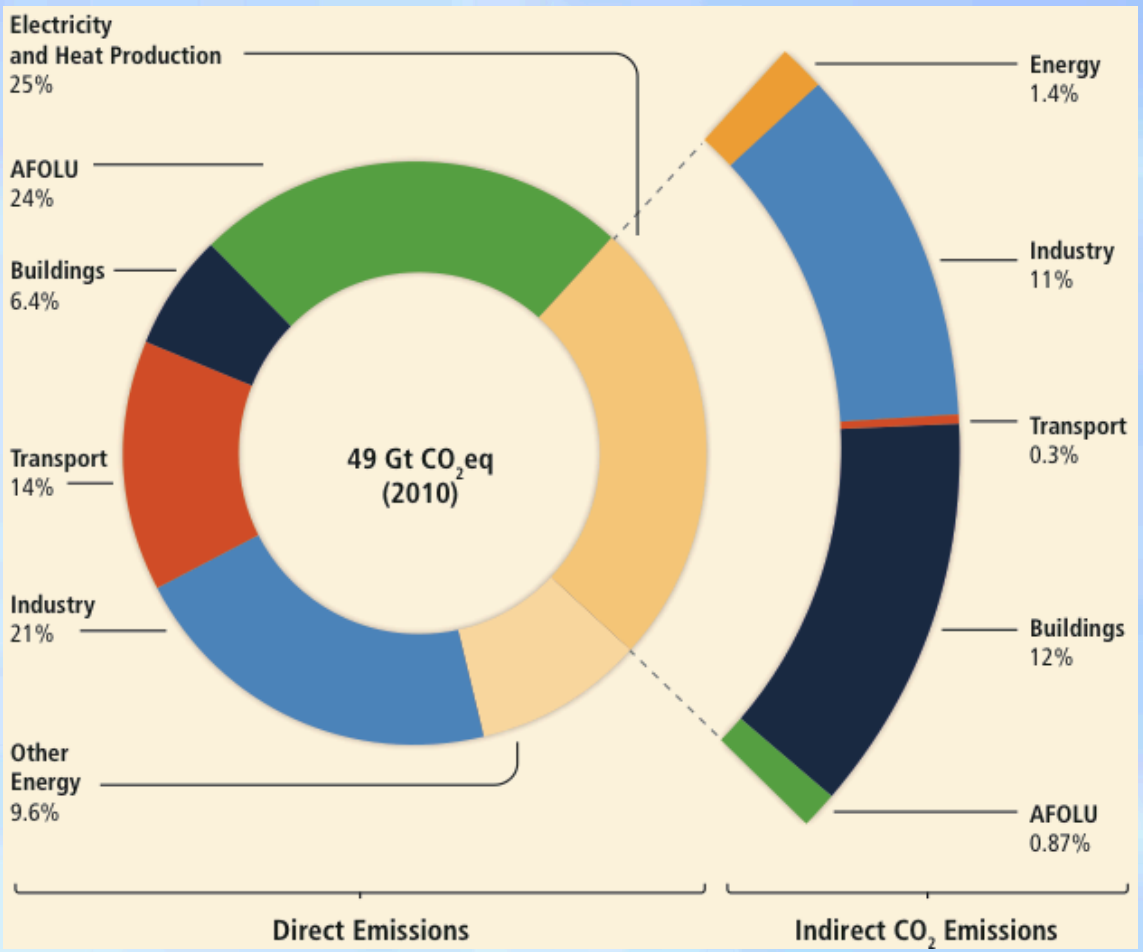
The importance of Mitigation

- Without additional efforts to reduce GHG emissions beyond those in place today, emissions growth is expected to persist driven by growth in global population and economic activities.
- Mitigation scenarios reaching about 450 ppm CO_2e in 2100 typically involve temporary overshoot of atmospheric concentrations, as do many scenarios reaching about 500 ppm to about 550 ppm CO_2e in 2100.



www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policymakers.pdf

GHG Emissions by Economic Sector



www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policymakers.pdf

Reductions in GHG emissions are necessary…

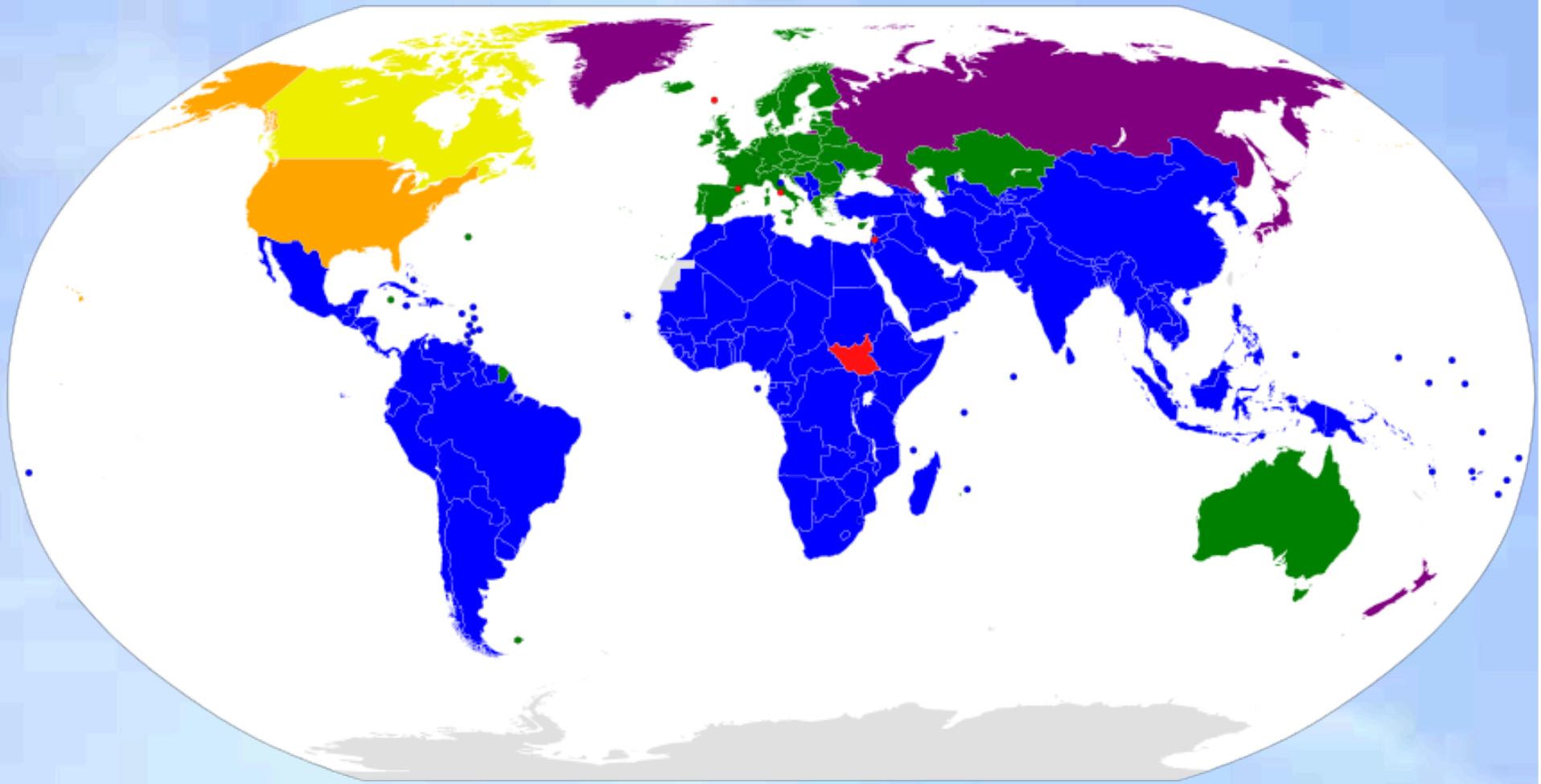
- IPCC 5th Assessment Report:
  - to keep average global temperature rise below 2°C,
  - a reduction in GHG emissions of 40-70% below 2010 levels in needed by 2050.
- Even this may be insufficient to keep food production at current levels when regional and local climate variations are taken into account.
- Likely to pave way for global, legally binding treaty on reducing carbon emissions at the UN Climate Conference (COP21) in Paris in December 2015.
- Submissions of Intended Nationally Determined Contributions (INDCs) have been invited.

The Kyoto Protocol (1997)

- The Kyoto Protocol is a protocol to the UNFCCC aimed at tackling global warming.
- Annex I countries (e.g. 39 industrialised countries) agreed to reduce their collective greenhouse gas emissions by 5.2% from 1991 levels.
  - Emission limits do not include emissions from international aviation and shipping
  - Each Annex I country is required to submit annual report of inventories of all anthropogenic greenhouse gas emissions from sources and removals from sinks under UNFCCC and the Kyoto Protocol.
- First commitment period: 2008-2012.
- Second commitment period (Doha Amendment): from 2012-2020 but needs 144 countries to ratify (43 so far).

http://unfccc.int/kyoto_protocol/doha_amendment/items/7362.php

Signatories to the Kyoto Protocol

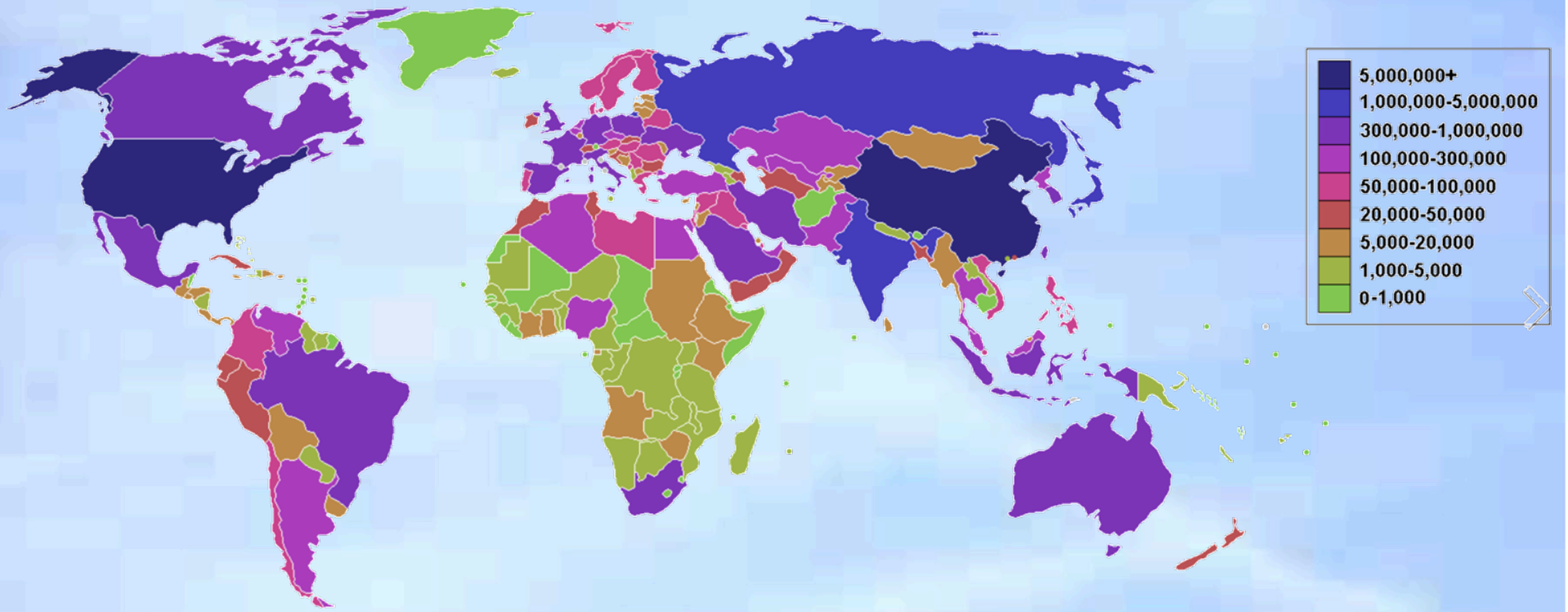


http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php

Obligations under Kyoto Protocol

- Puts obligation on developed (Annex 1) countries to reduce current GHG emissions as they are historically responsible for current levels of GHGs in atmosphere.
- GHG emission reduction targets (from 1990) levels are listed in Annex B.
- Non-Annex 1 (developing) countries should submit National Appropriate Mitigation Actions (NAMAs).
- Virtually all non-Annex I countries have established a "designated national authority" to manage their Kyoto obligations:
  - specifically the 'CDM process' that determines which GHG projects they wish to propose for accreditation by the Clean Development Mechanism (CDM) Executive Board.
- 33 countries have so far submitted INDCs to COP21.
  - EC will submit INDC to COP21 stating their intention to reduce emissions by 40% by 2030.

Countries by CO_2 emissions (in thousands of tonnes per annum)



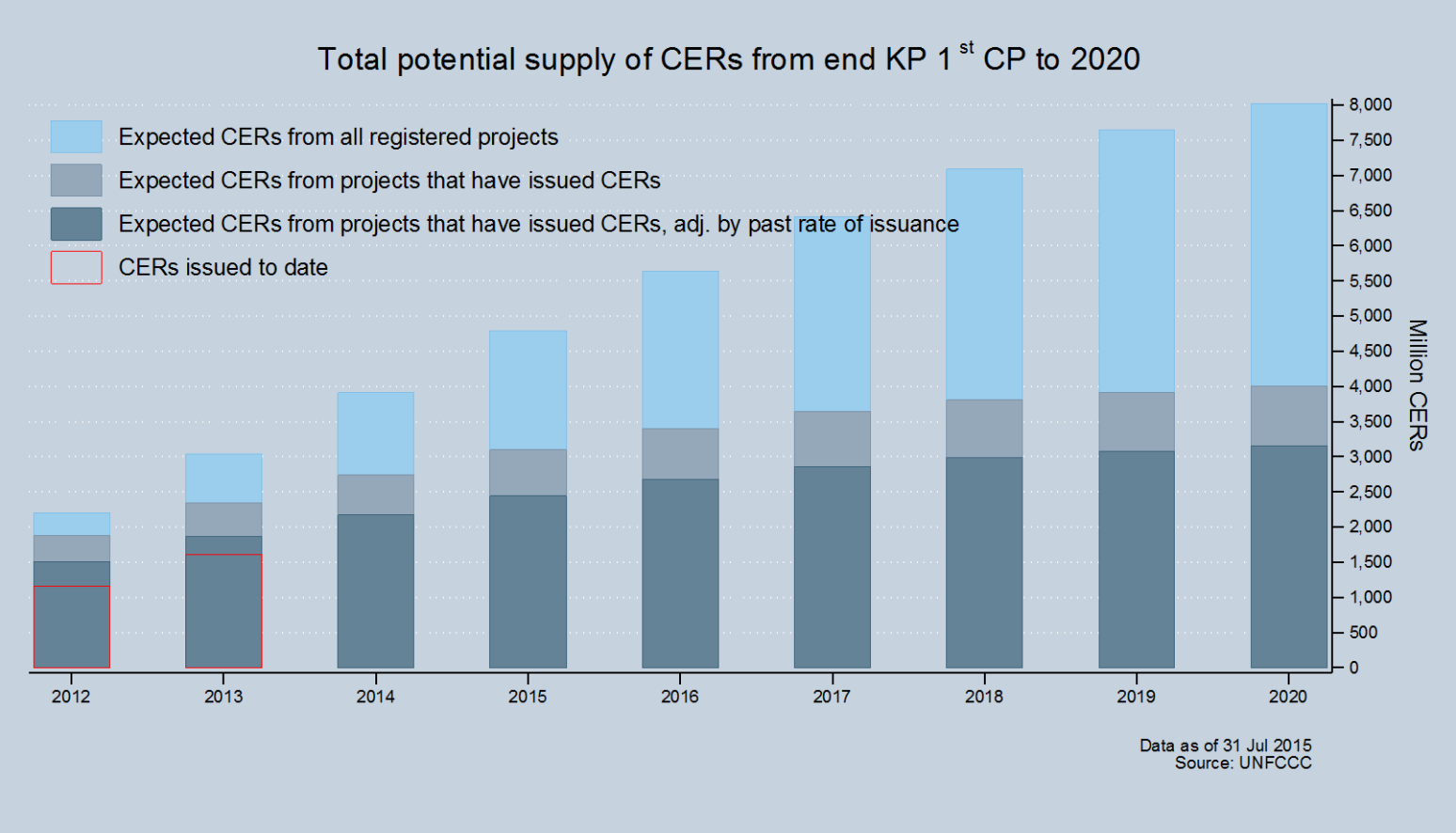
http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions

Distribution of CDM projects

as of 31 July 2015

http://cdm.unfccc.int/Statistics/Issuance/CERsIssuedByHostPartyPieChart.html

Potential supply of CERs 2012-2020

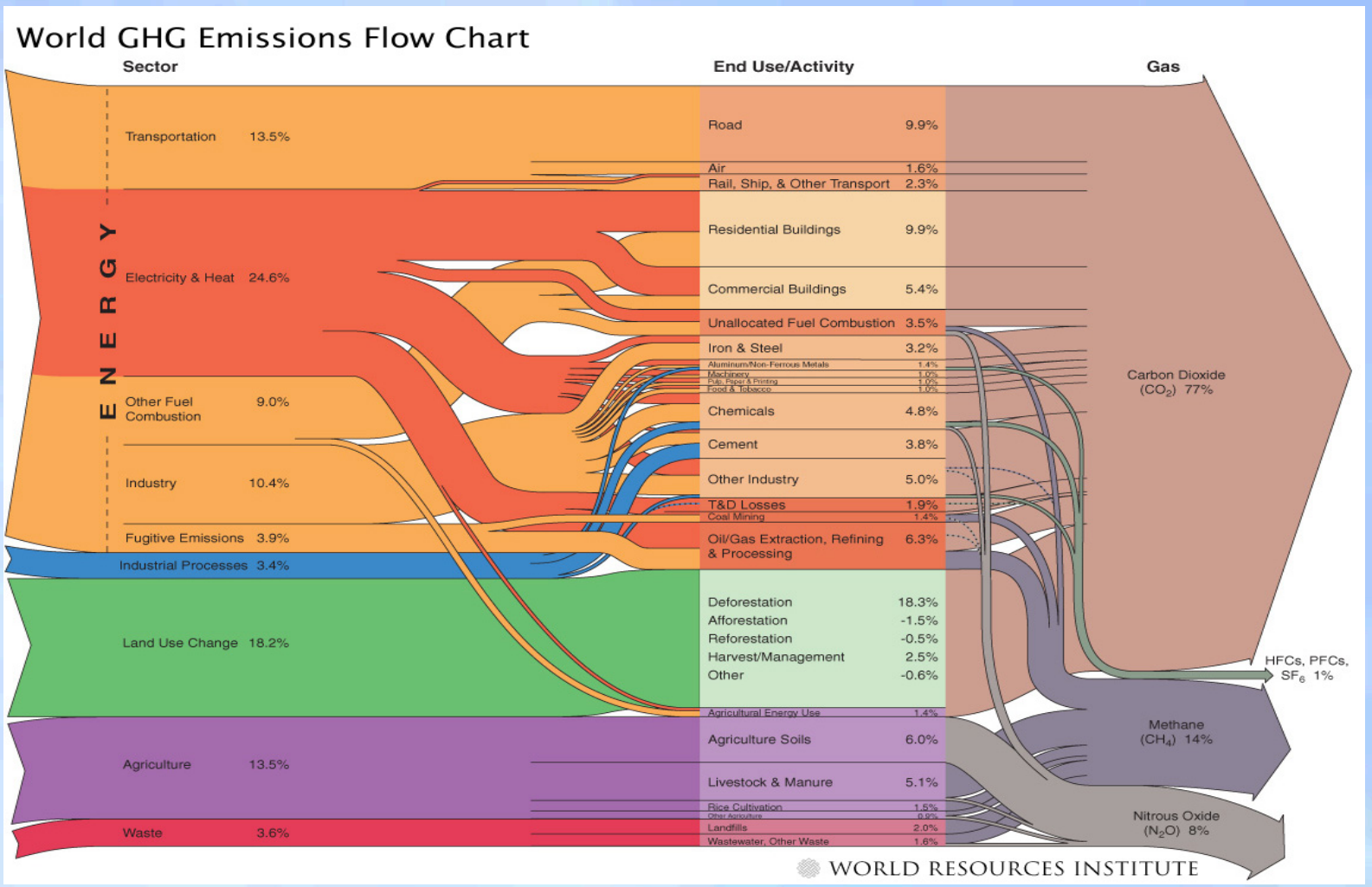


http://cdm.unfccc.int/Statistics/Public/CDMinsights/index.html

Energy

- Where energy comes from and where it goes.
- Mitigation actions required from Energy sector.
- Understanding the difference between energy and electricity and GHG emissions from each.
- A look at best practises on energy/electricity generation and use in various countries.
- How to move towards a better electricity generation mix for a country.

Energy: where it come from and where it goes



www.wri.org

Mitigation actions necessary

- Decarbonizing electricity generation is a key component of cost effective mitigation strategies in achieving low stabilization levels (430–530 ppm CO_2e). Decarbonization will happen more rapidly in electricity generation than in industry, buildings and transport sectors.
- Mitigation scenarios reaching around 450 ppm CO_2e concentrations by 2100 show large-scale global changes in the energy supply sector.
- GHG emissions from energy supply projected to decline by 90 % or more below 2010 levels between 2040 and 2070.

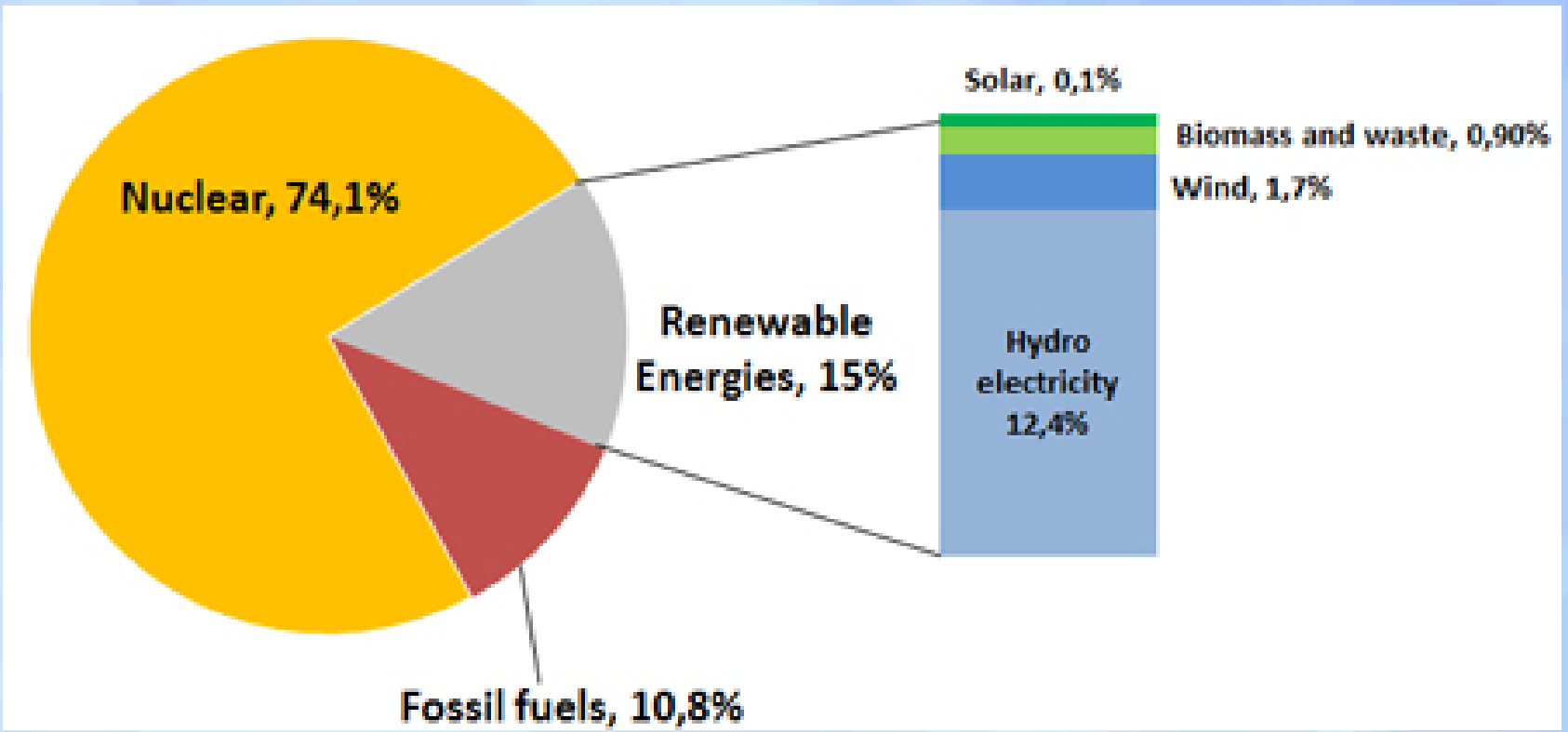
www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policymakers.pdf

Ways to achieve a 90% reduction in GHG emissions

- Increase share of Nuclear energy - a mature low-GHG emission source of baseload power but share of global electricity generation has been declining (since 1993). However, a variety of barriers and risks exist.
- Replace coal-fired power plants with modern, highly efficient natural gas combined-cycle power plants or combined heat and power plants.
- Use CO_2 capture and storage (CCS) technologies to reduce lifecycle GHG emissions of fossil fuel power plants.
- Combining bioenergy with CCS (BECCS) offers the prospect of energy supply with large-scale net negative emissions which plays an important role in many low-stabilization scenarios, while it entails challenges and risks.

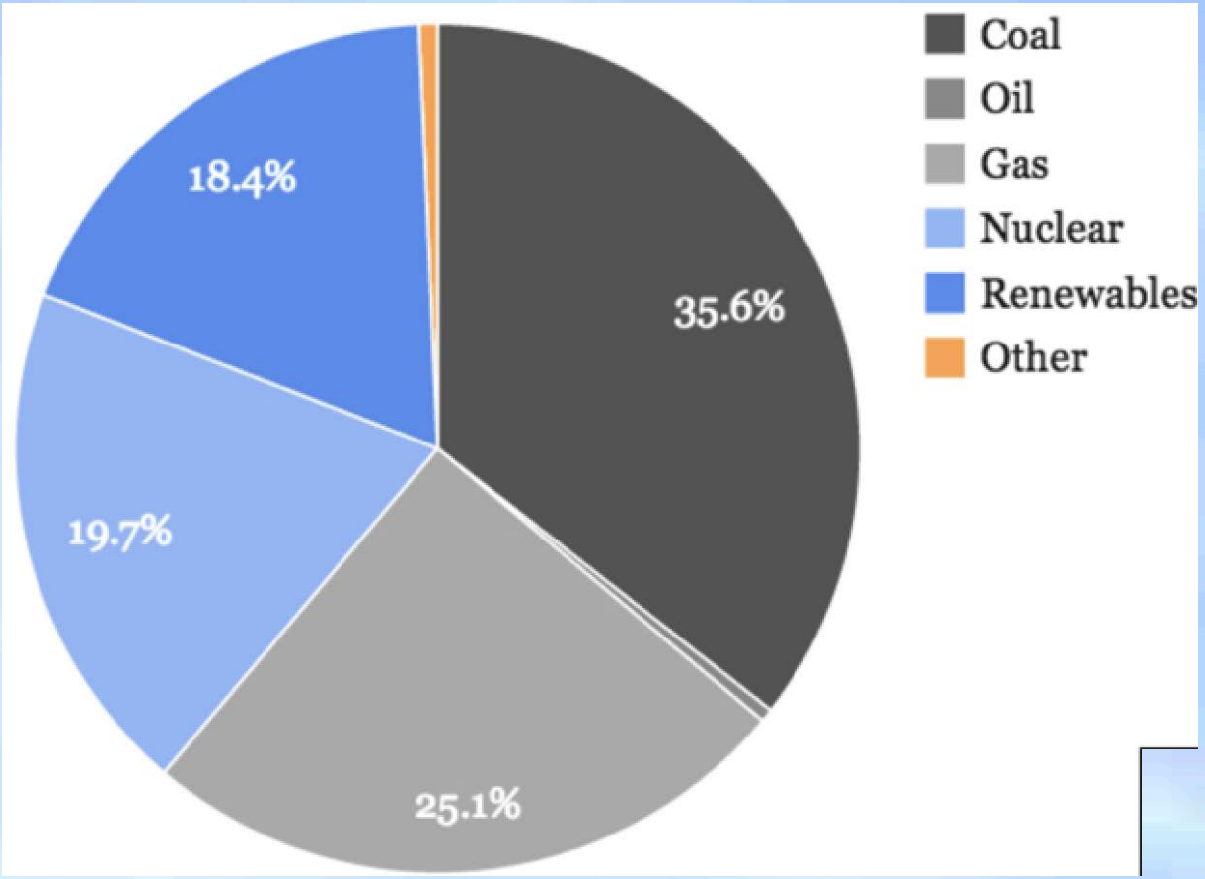
www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policymakers.pdf

Example: France's Electricity Mix



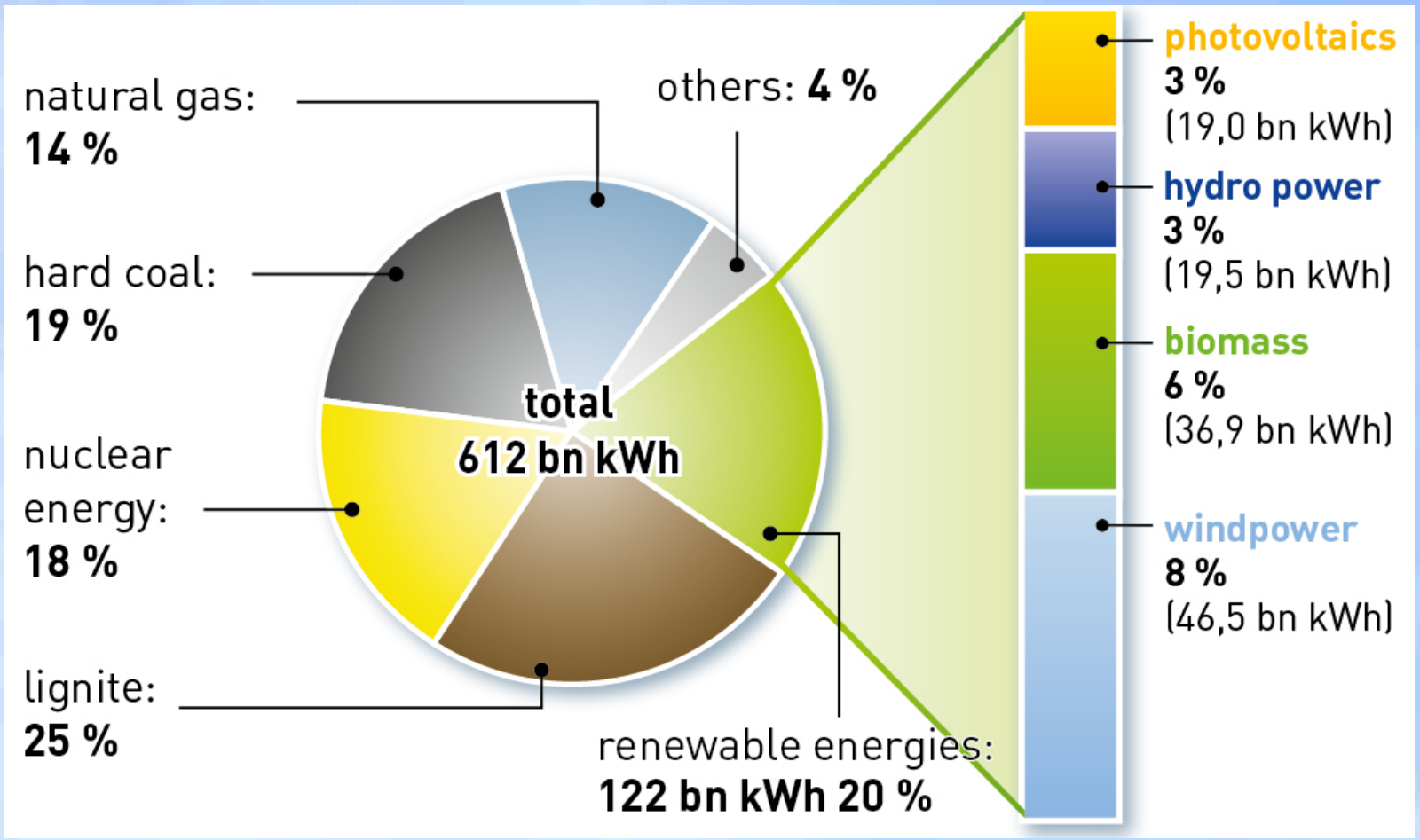
www.electrical-efficiency.com/2012/08/european-electricity-come-from/

Example: UK's Electricity Mix



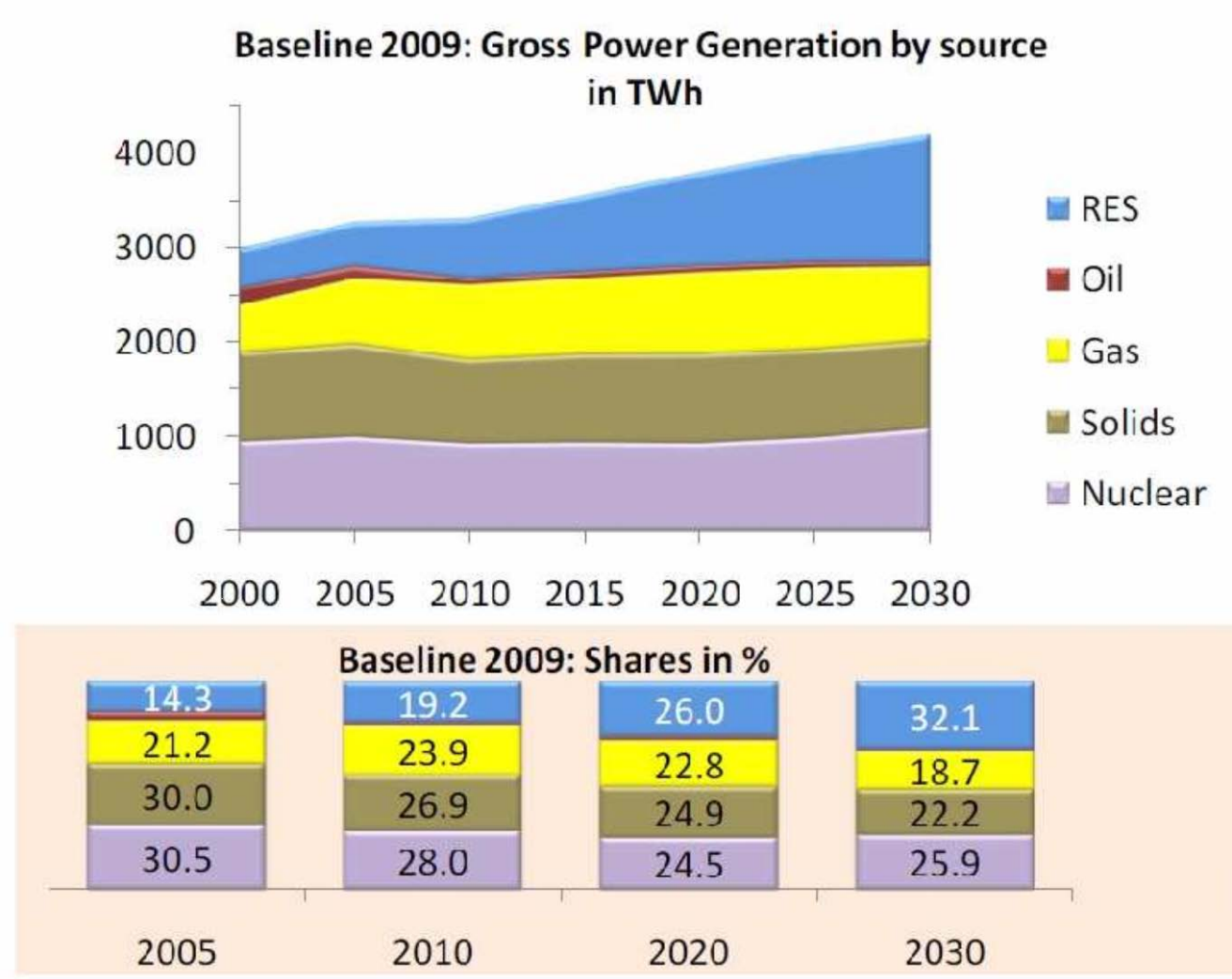
The Carbon Brief: www.carbonbrief.org/blog/2014/03/2013's-stormy-weather-leads-to-record-levels-of-renewable-electricity

Example: Germany's Electricity Mix



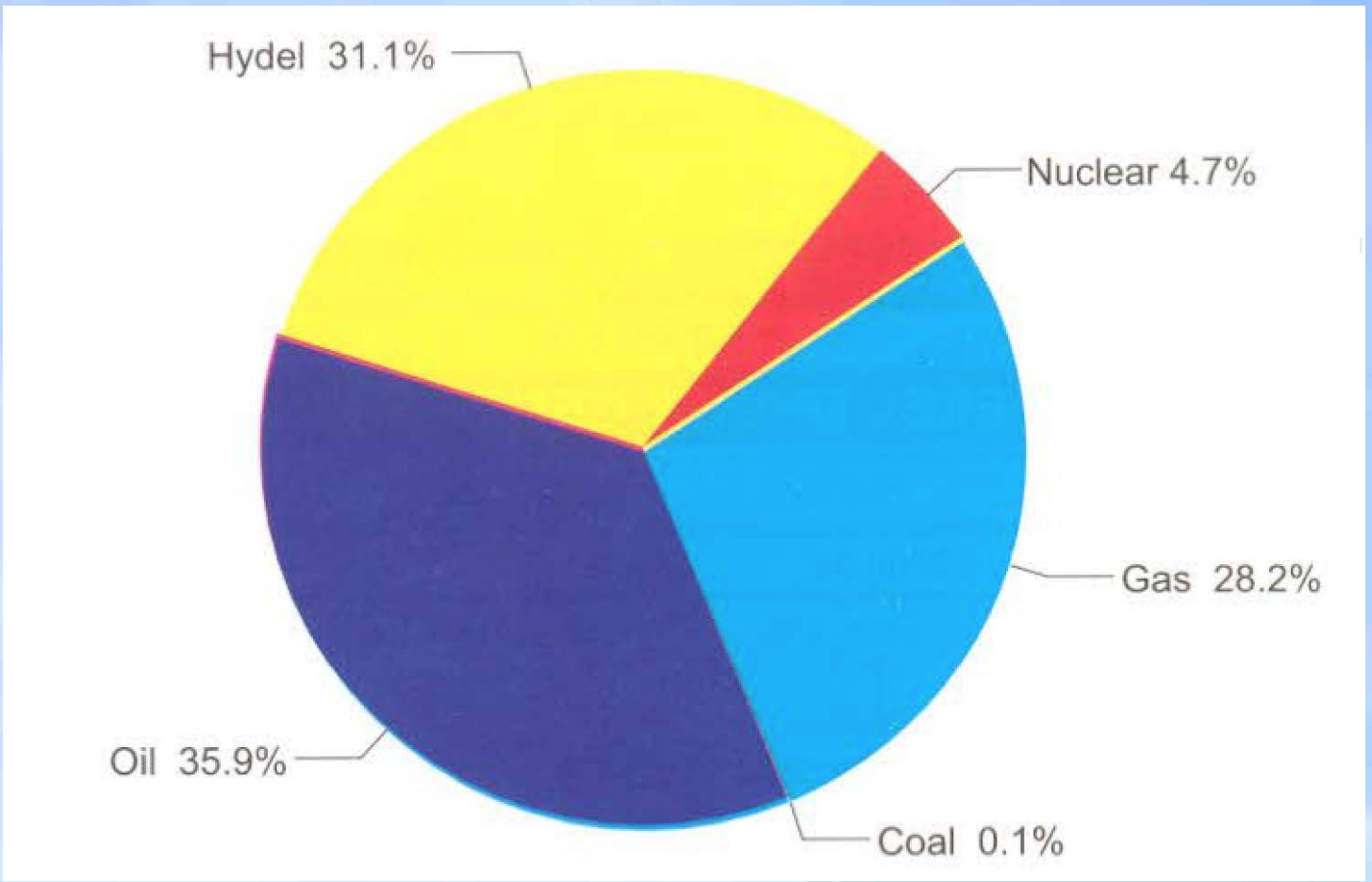
www.renewables-in-germany.de

Example: Energy trends in EU to 2030



http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2030_update_2009.pdf

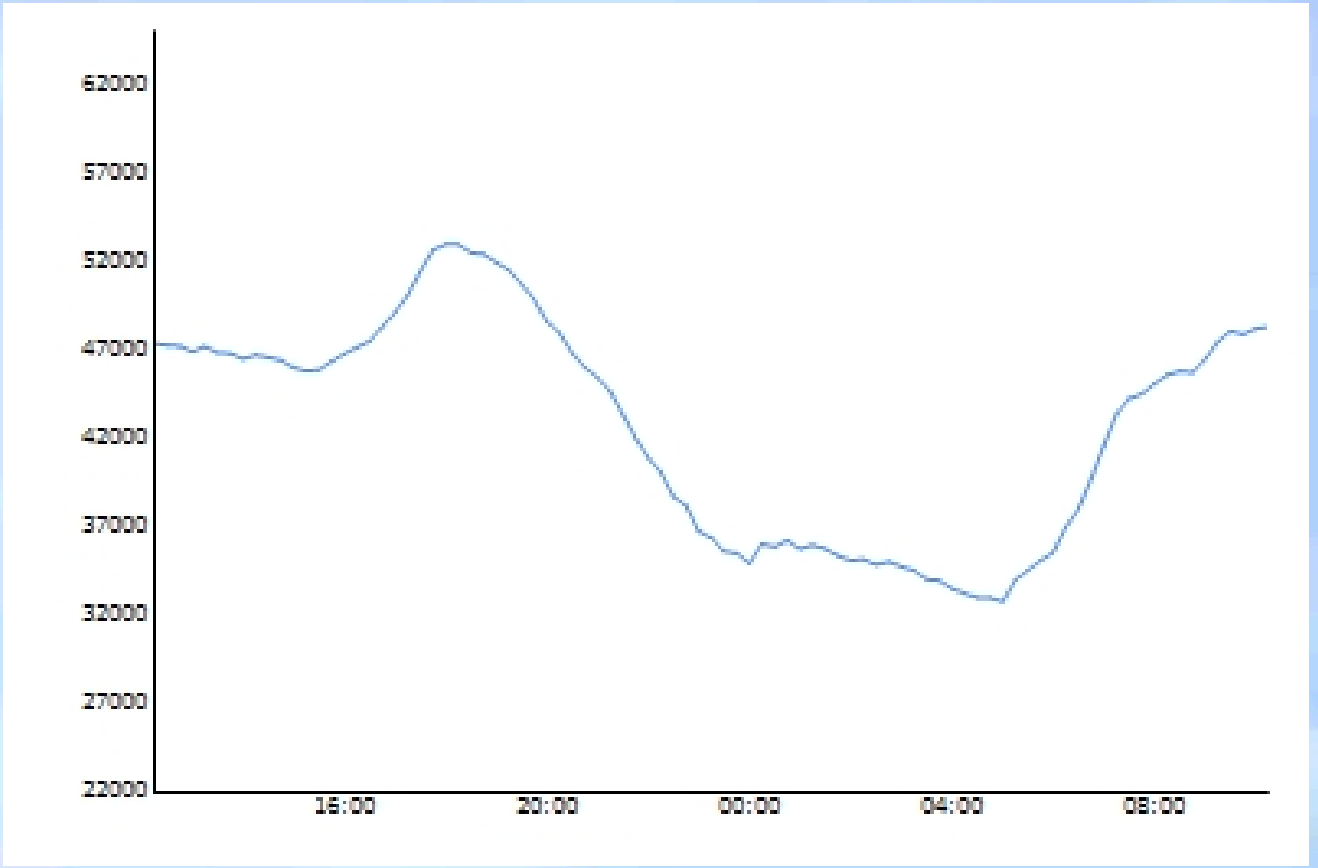
Example: Pakistan's Electricity Mix



Source: Pakistan Energy Yearbook 2013, Ministry of Petroleum and Natural Resources, Islamabad, April 2014.

Electricity Demand over 24 Hours

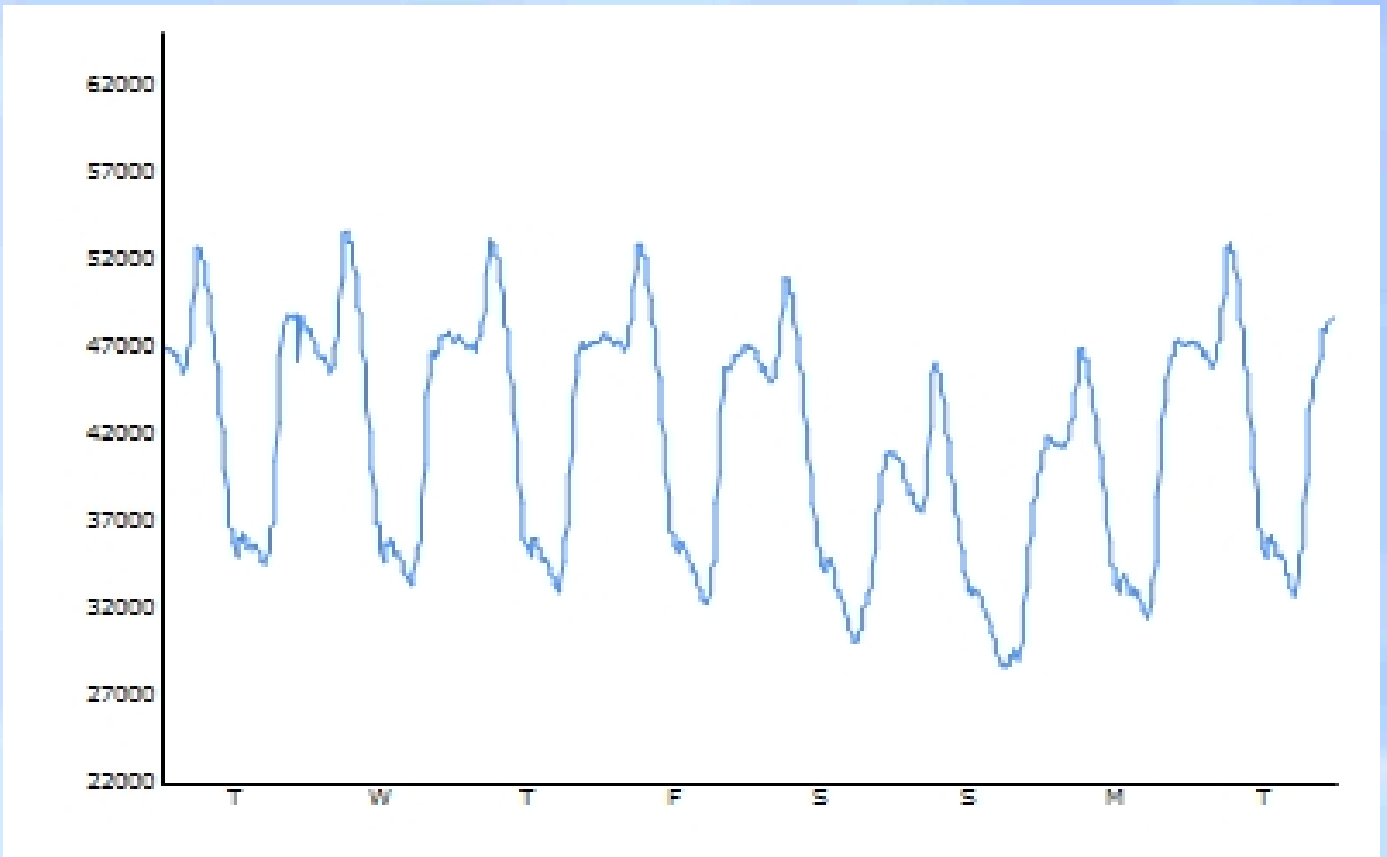
MW



www.nationalgrid.com

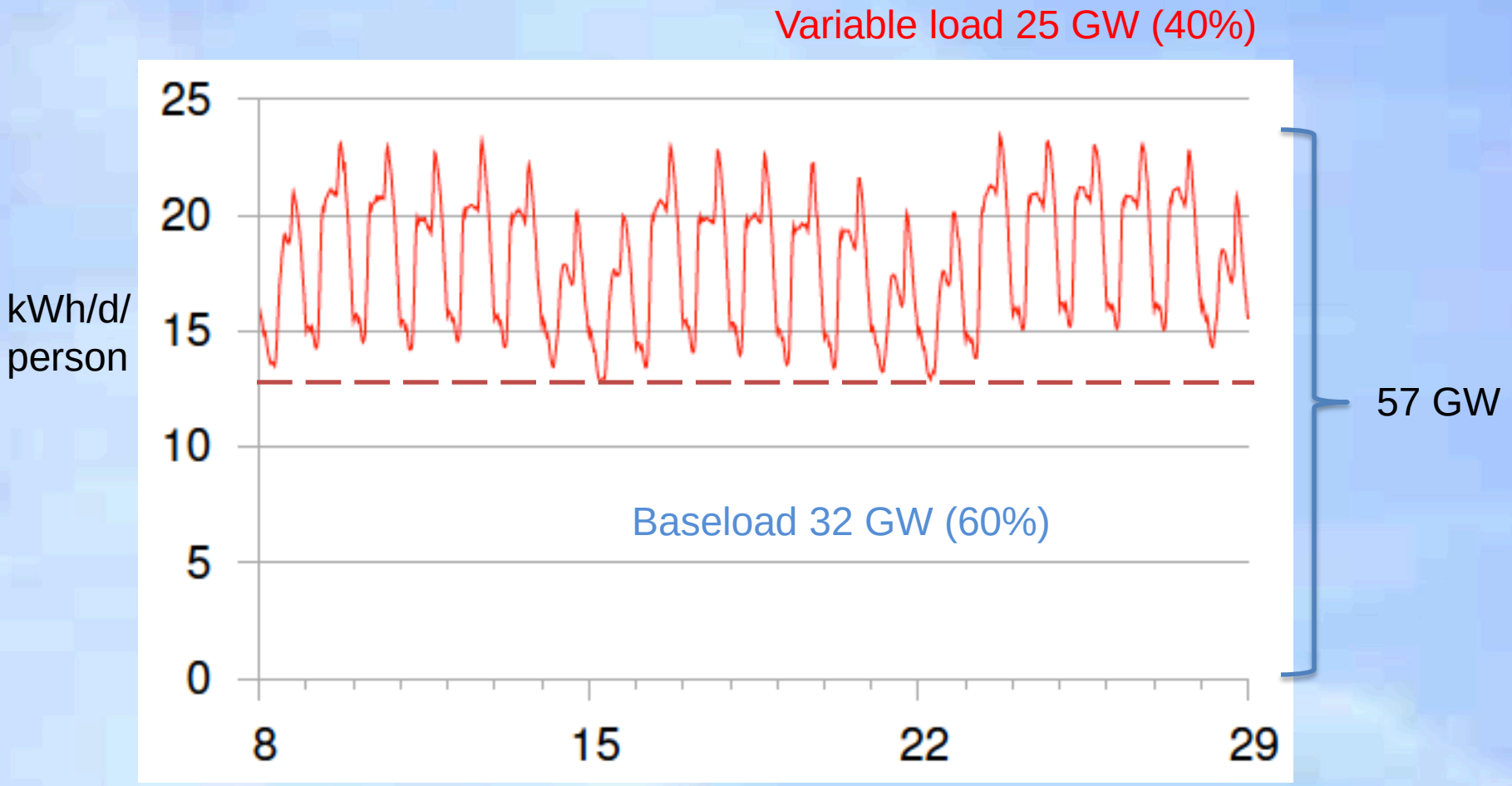
Electricity Demand over a week

MW



www.nationalgrid.com

Electricity Demand in January (UK)



www.nationalgrid.com

Electricity Generation Mix

- Coal
- Gas

takes hours to start-up/shut down – use for hot standby

- Nuclear

takes 30 hours to start up and shut down – use for baseload

- Renewables

variable/unreliable/intermittent – use as available

- Pumped Storage
- HVDC imports

for rapid start-up/shut-down

Energy Generation - Conclusions

- So we've learned how a change to a country's energy mix (some of which must be enabled by ICT) can have a substantial effect on its GHG emissions.
- But ICT can do a lot more for the Energy sector …as we will learn in Session 7 tomorrow when we deal with Green ICT Technologies.

Introduction to Information & Communication Technologies (ICTs)

- Who provides them?
- Who uses/owns them?
- Why are they so important in tackling Climate Change?

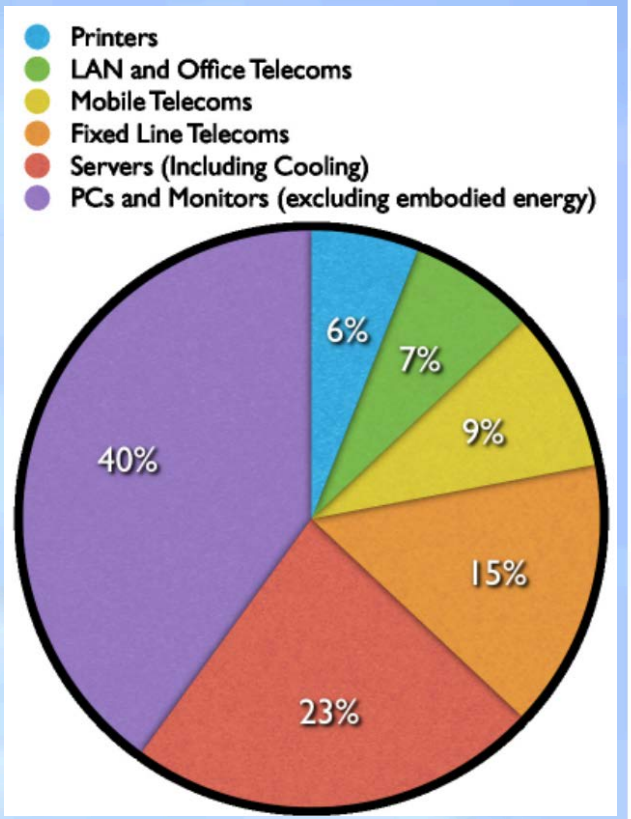
ITU and climate change

Types of ICTs

ICTs cover a wide range of technologies for gathering, storing, retrieving, processing, analysing and transmitting information in digital form, including:

- Telecommunications Equipment (e.g. switches, routers, mobile base stations)
- IT Equipment (e.g. Cloud Servers)
- Personal devices (e.g. TVs, laptops and iPads)
- Power supplies to telecom infrastructure (e.g. towers)

What impact do these have on GHG emissions?



Source: http://css.escwa.org.lb/ictd/1248/25.pdf

Roles of ICTs in tackling climate change

- Climate change monitoring (providing data from satellite, airborne, terrestrial and oceanic sensors).
- Applying ICTs to reducing emissions in other sectors (mitigation), e.g. in the power sector.
- Improving the energy efficiency of the ICTs themselves.
- Applying ICTs to improving adaptation to climate change.

More detail on these is provided in Session 2.

Most important ways to reduce energy consumption through ICTs

1. Improve efficiency of power plants.
2. Reduce losses from power generation, e.g. optimise electricity grid.
3. Use more renewables in electricity generation.
4. Use ICTs to reduce energy consumption in other sectors (15%).
   - Focus first on Transport sector.
5. Improve energy efficiency of ICTs themselves (2.5%).

More detail provided in Session 7.

Introduction to role of regulators and policy makers in ICT & Climate Change

Most important policy makers?

- National Climate Change policy.
- Energy policy.
- Transport policy.
- Telecommunications / ICT policy.

Many others, e.g:

- industrial sector
- cities and urban development
- water management.

Policy options identified here – will be revisited in Session 8.

National Climate Change Policy

In order to reduce energy consumption and GHG emissions, governments of Developing (non-Annex 1) Countries should consider:

- drafting and agreeing a National Climate Change Policy,
- Putting in place a national mitigation plan to show how carbon emissions can be reduced using ICTs,
  - and submitting an INDC to COP21
- seeking funding from the Green Climate Fund (GCF) to enable projects to be implemented,
- registering projects under the CDM to exploit carbon credits, in particular for projects involving hydro and renewable energy.

National Energy Policy options

In order to reduce energy consumption and GHG emissions, National Energy Regulators could consider (examples):

- encouraging a switch away from use of fossil fuels,
- mandating the roll out of smart meters to all homes and businesses in order to reduce electricity consumption,
- Reducing GHG emissions by planning as high a proportion of renewables in power generation that the grid will allow,
- subsidising the roll out of renewable energy technologies to achieve the above, especially community energy projects,
- paving the way for the implementation of a Smart Grid and an Electric Vehicle charging infrastructure.

More detail on how to do this will be provided on Wednesday and Thursday.

National Telecommunications Policy

Policy Makers / Regulators can play an important role in reducing energy consumption and GHG emissions by (examples):

- accelerating the deployment of high speed broadband so that e-services can be rolled out effectively,
- putting in place a policy encouraging infrastructure sharing in both fixed and mobile networks,
- permitting different site sharing tariffs to be levied when renewable or battery power is provided,
- moving from a passive to an active BTS site sharing policy,
- looking at how the move to a 5G mobile network architecture would impact on the provision of renewable energy to BTS sites,
- adopting and promoting Green ICT standards,
- adopting and enforcing appropriate e-waste policies.

More detail on how to do this is provided in Sessions 3, 4, 7.

Summary

- Climate change is happening and will have an impact on all our lives.
- Human activities are leading to possibly irreversible changes to global climate.
- The generation and consumption of electricity is one of the leading contributors to climate change.
- Electricity grids are being re-designed to emit 90% less GHGs by 2050 - this needs to happen everywhere.
- ICTs can help to reduce the impact of climate change.
- Policy makers and regulators should ensure that ICTs are used effectively to tackle climate change.

References for further reading:

- IPCC 5th Assessment Report: Climate Change 2014 Synthesis Report Summary for Policymakers www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf
- IPCC Climate Change 2014 Mitigation of Climate Change, Summary for Policymakerswww.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policymakers.pdf
- ITU-D SG 2 Report Question 24/2 ICT and climate change http://www.itu.int/pub/D-STG-SG02.24-2014
- ITU Reports on ICT & Climate Change including:
  - "Climate Change Adaptation and ICTs: The Case of Ghana".
- National policy documents including UK Climate Change Act 2008.
- National Energy Yearbooks providing figures for energy and electricity consumption.
- Real time information on energy consumption, e.g. http://www2.nationalgrid.com/uk/Industry-information/Electricity-transmission-operational-data/Data-Explorer/
- Examples of National electricity generation mixes (renewables and non-renewables), e.g. www.unendlich-viel-energie.de/media-library/charts-and-data/germanys-power-mix-in-2013.
- Energy for a Changing World: www.managenergy.net/resources/881#.VfCkjun87A0