Seminar on
Mainstreaming Energy Sustainable Development Goals (SDGs), Target and Indicators into Statistical Programmes of Select African Countries

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Energy Indicators for Sustainable Development: Environmental Dimensions

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Environmental dimensions of energy production and use

- **Air / Atmosphere**
  - pollutants degrade air quality (indoor and/or ambient)
  - greenhouse gas emissions (linked to climate change)
- **Water**
  - water quality (discharges and contamination)
- **Land**
  - soil quality concerns
  - deforestation issues
  - waste generation and disposal.

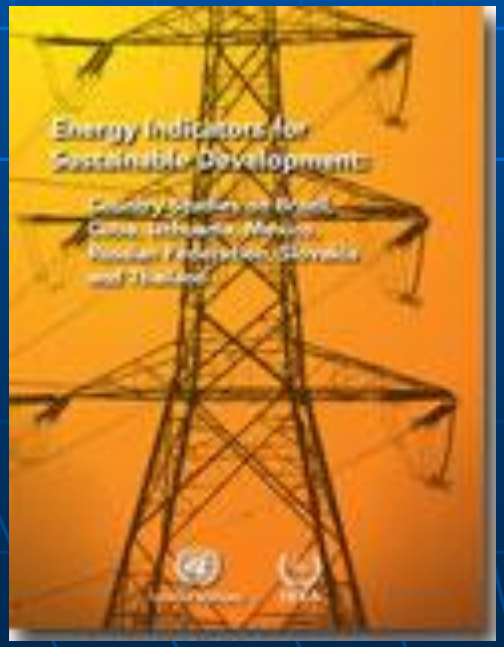
Energy Indicators fir Sustainable Development

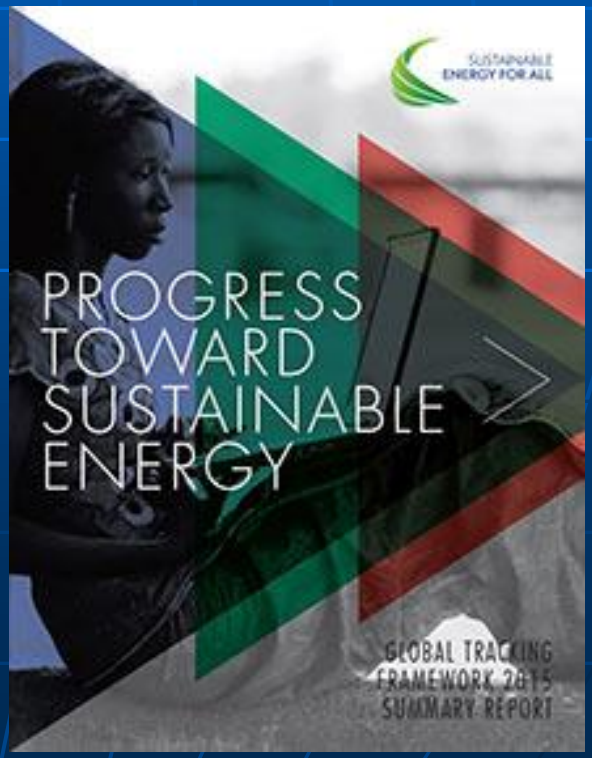
Common methodology:

4 social indicators

16 economic indicators

10 environmental indicators





Environmental dimension indicators

Environmental			
Theme	**Sub-theme**	**Energy Indicator**	
Atmosphere	Climate Change	ENV1	GHG emissions from energy production and use per capita, per GDP and per unit of electricity
	Air quality	ENV2	Ambient concentrations of air pollutants in urban areas
		ENV3	Air pollutant emissions from energy systems
Water	Water quality	ENV4	Contaminant discharges into liquid effluents from energy systems
Land	Soil quality	ENV5	Concentration of contaminants from energy systems in soils
	Forest	ENV6	Rate of deforestation attributed to energy use
	Solid Waste generation & management	ENV7	Solid waste generation by type per energy produced
		ENV8	Ratio of solid waste properly disposed of to total generated solid waste
		ENV9	Solid radioactive waste generation per energy produced
		ENV10	Ratio of solid radioactive waste awaiting disposal to total generated solid radioactive waste

Environmental Indicator 1: Atmosphere (Climate Change)

Data needed:

- GHG emissions from energy production and use per capita, per GDP and per unit of electricity

Notes:

- Energy related GHG emissions in participating African countries are at a very low level, but expected to raise in future;
- Most electricity production in sub-Sahara Africa is based on hydropower (low carbon intensity);
- Challenges in measuring (informal trade and) consumption of traditional biomass (and related climate emissions);

Indicators and Information concerning Climate Change

	t CO2/ capita	Kg CO2/ unit of GDP		National Reports to UNFCCC	
Cameroon	0.27	0.27		2002	2016
Ethiopia	0.09	0.31		2001	2016
Ghana	0.53	0.68		2001	2015
Kenya	0.26	0.42		2002	2015
Rwanda	no data	no data		2005	2012
Senegal	0.42	0.53		1997	2016
Sierra Leone	no data	no data		2007	2012
Togo	0.24	0.58		2002	2014
Uganda	no data	no data		2002	2014
Zambia	0.24	0.22		2002	2014
South Africa	7.91	1.30		2003	2013
United States	16.18	0.35			

Source: Internationl Enegry Agency and UNFCCC Secretariat
http://www.iea.org/statistics

Environmental Indicator 1: Atmosphere (Climate Change)

Data needed:

- Multiple interlinkages between climate, precipitation, environmental factors and **productivity of hydropower**

  Notes:

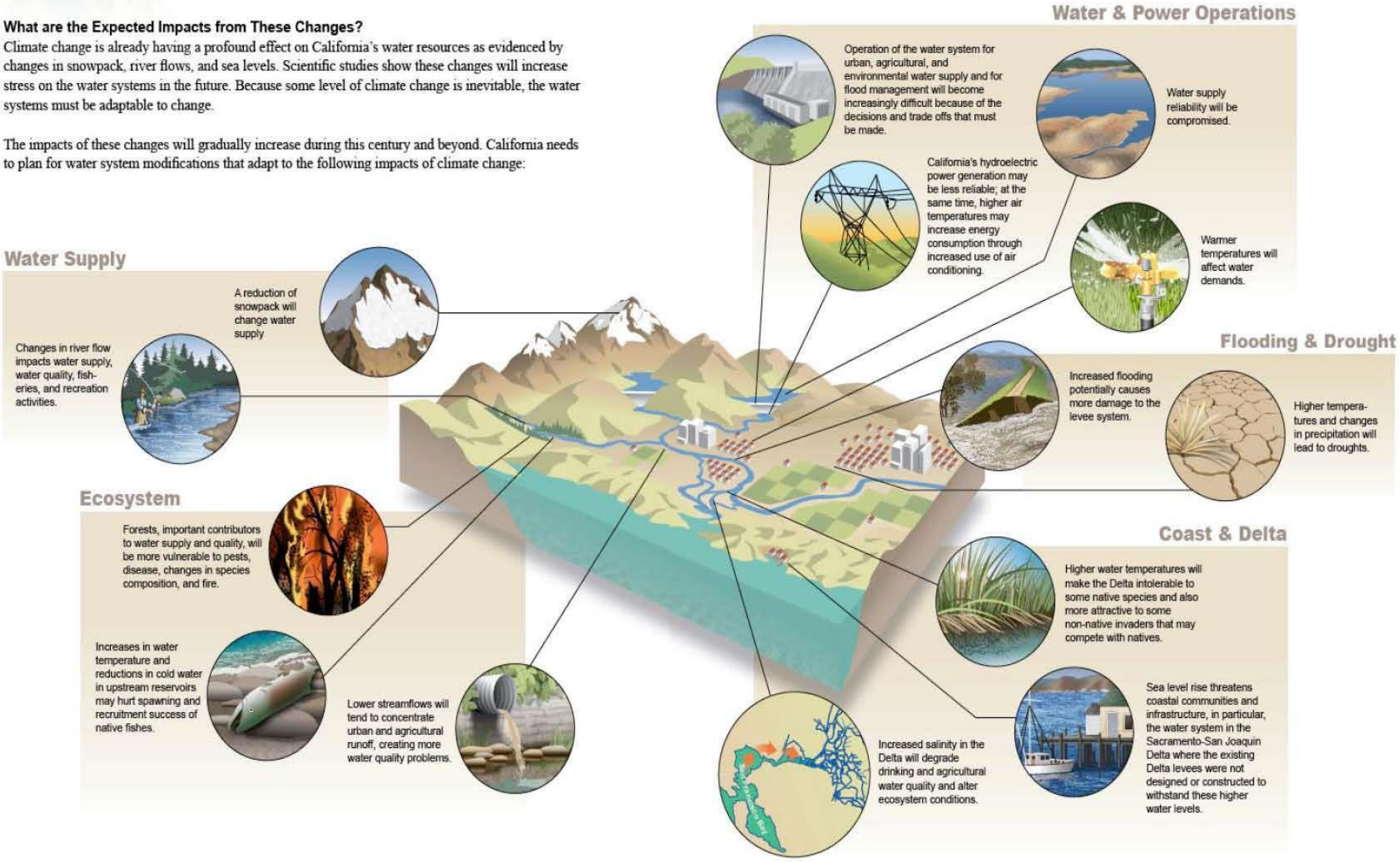
  - electric power production in participating African countries largely depends on hydropower ;
  - production of hydropower, local climates and environmental conditions are closely interlinked;
  - recording and analyzing relevant climate and other environmental data can be crucial for planning and projecting hydropower production;

Climate Change: *Stressing Our Water Systems*

What are the Expected Impacts from These Changes?

Climate change is already having a profound effect on California's water resources as evidenced by changes in snowpack, river flows, and sea levels. Scientific studies show these changes will increase stress on the water systems in the future. Because some level of climate change is inevitable, the water systems must be adaptable to change.

The impacts of these changes will gradually increase during this century and beyond. California needs to plan for water system modifications that adapt to the following impacts of climate change:



Interim conclusion/recommendations:

- Collection of data on GHG emissions from energy production and use in sub-Sahara Africa is needed/desirable (even if current emissions are comparatively low);
- Collection and analysis of other local/regional climate data can be useful for projection of energy production from renewables (including hydropower);

Environment Indicator 2 & 3: Air quality and air pollutant emissions from energy systems

Data needed:

Ambient concentrations of air pollutants in urban areas

- … such as carbon monoxide (CO), lead (Pb), Nitogen dioxide (NO2). Ozone (O3), particulate matter (PM2.5, PM10), sulphur dioxide (SO2),
- Data collection should comply with recommended WHO International Guidelines and include time and spatially representative concentrations, such as mean annual concentrations or percentile concentration as well as information on site and location

Air Quality Guidelines (WHO)

Pollutant	Concentration	Averaging Period
Particulate matter ($PM_{2.5}$)	10 µg/m³ 25 µg/m³	1 year 24 hour
Particulate matter (PM_{10})	20 µg/m³ 50 µg/m³	1 year 24 hour
Ozone	100 µg/m³	8 hour
Nitrogen dioxide	40 µg/m³ 200 µg/m³	1 year 1 hour
Sulphur dioxide	20 µg/m³ 500 µg/m³	24 hour 10 minute

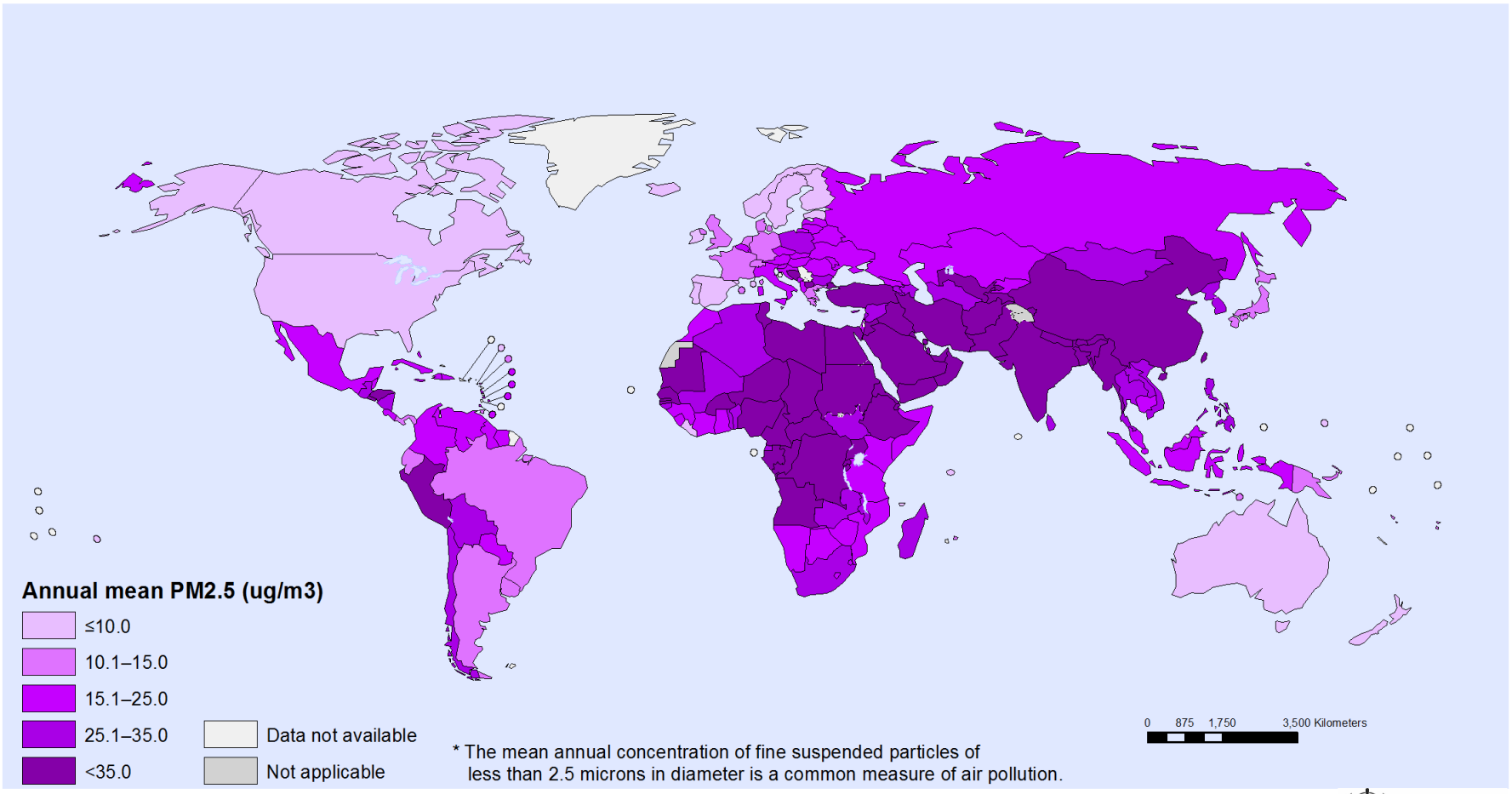
World Health Organization (WHO), 2006: Air Quality Guidelines

Notes

- local urban air pollution is mostly caused by local sources, hence
- assessment and measurement of air quality should be undertaken locally, with a view to
- establish and enforce an emission reduction strategy, if needed

Photo: Ethiopian Tribune – online edition – 15 June 2015

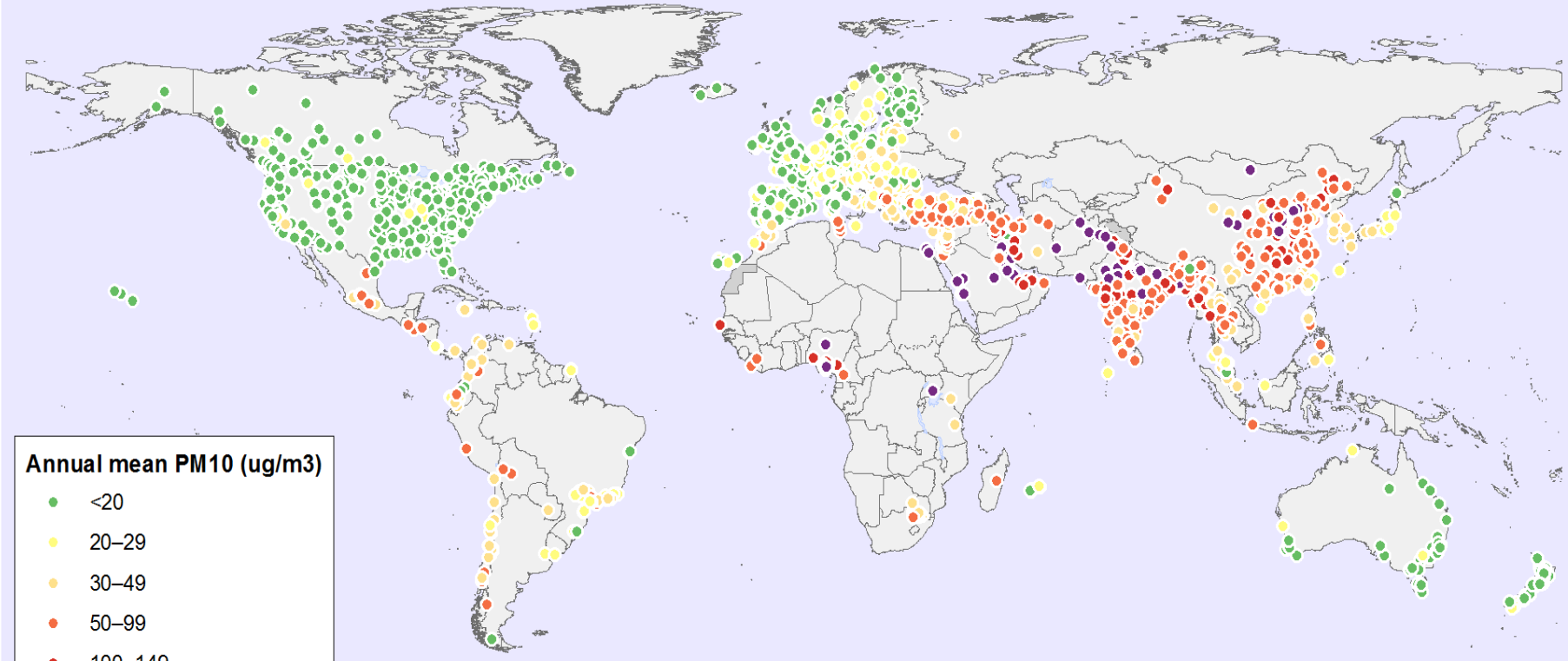
Annual mean concentrations of fine particulate matter (PM2.5) in urban areas (µg/m3), 2014*



Data Source: World Health Organization
Map Production: Information Evidence and Research (IER)
World Health Organization

World Health Organization

Concentration of particulate matter with an aerodynamic diameter of 10 µm or less (PM10) in nearly 3000 urban areas*, 2008–2015

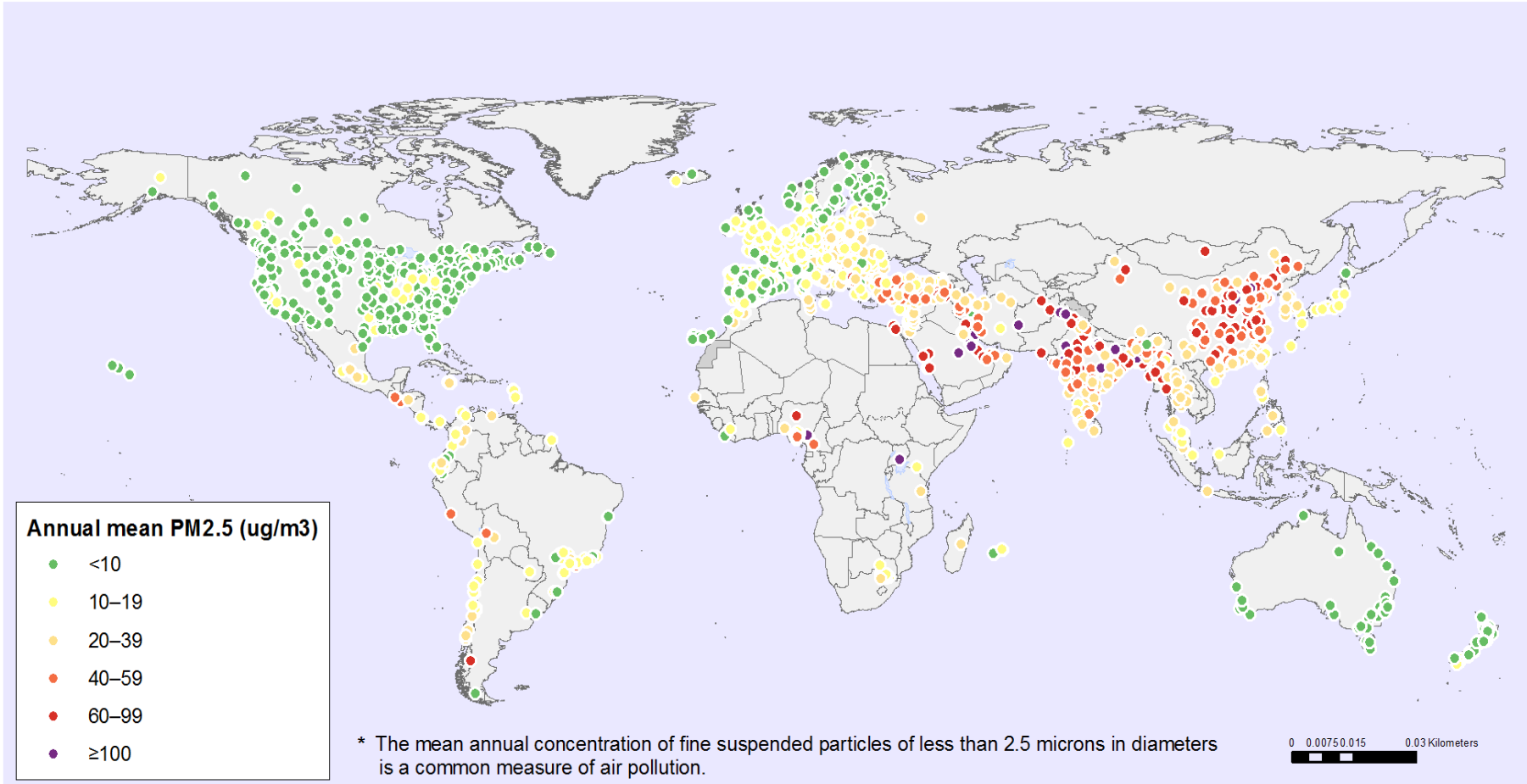


* The mean annual concentration of fine suspended particles of less than 10 microns in diameters is a common measure of air pollution.

Data Source: World Health Organization
Map Production: Information Evidence and Research (IER)
World Health Organization

World Health Organization

Concentration of particulate matter with an aerodynamic diameter of 2.5 µm or less (PM2.5) in nearly 3000 urban areas*, 2008–2015



Data Source: World Health Organization
Map Production: Information Evidence and Research (IER)
World Health Organization

World Health Organization

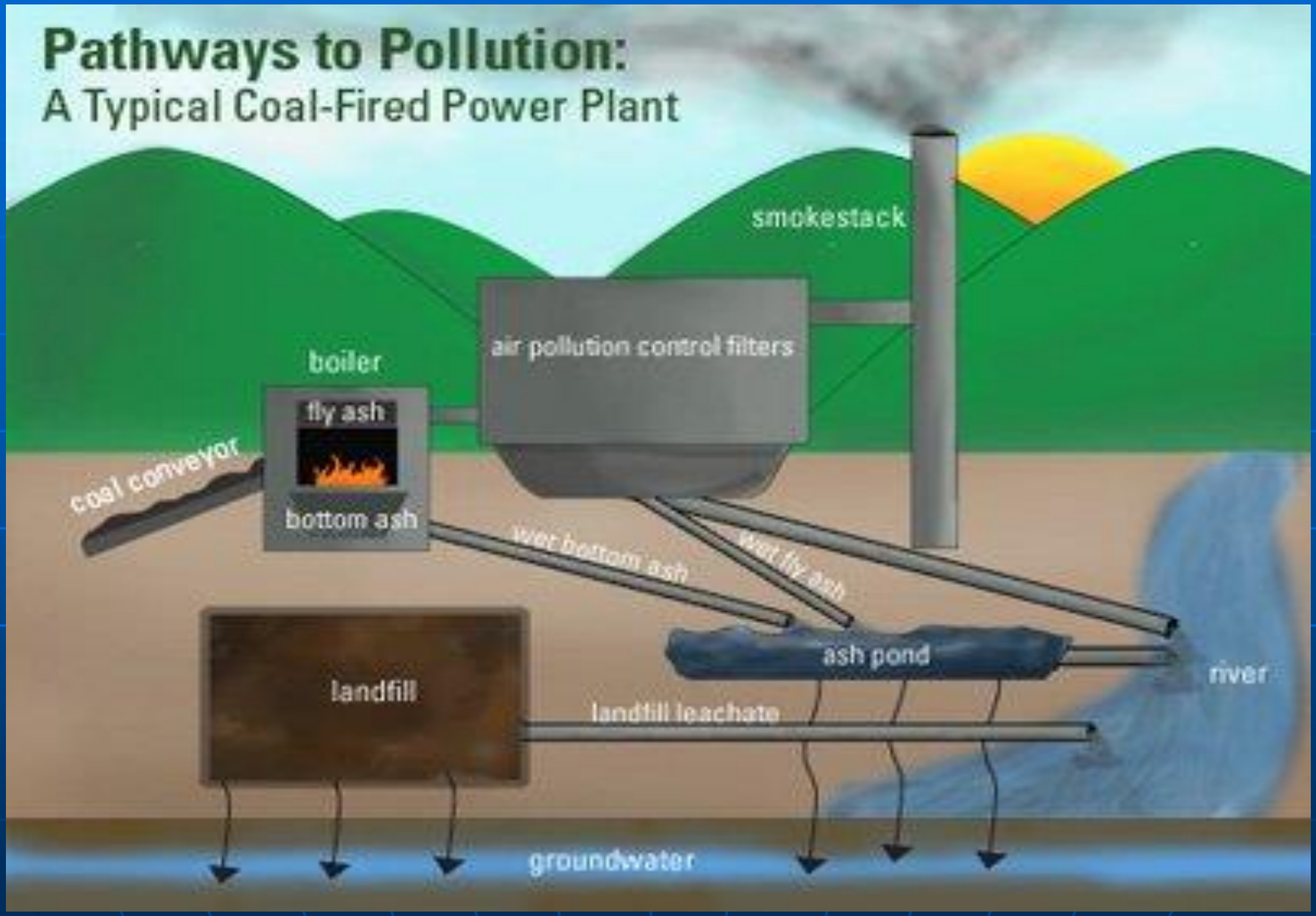
Interim conclusion/recommendations:

- Collection and analysis of relevant local/regional air quality data is an essential precondition for local policies and measures to ensure adequate urban air quality and healthy air;
- Inter-Ministerial/inter-institutional cooperation needed;
- Adequate budgets, equipment and operational training/capacity building needed;

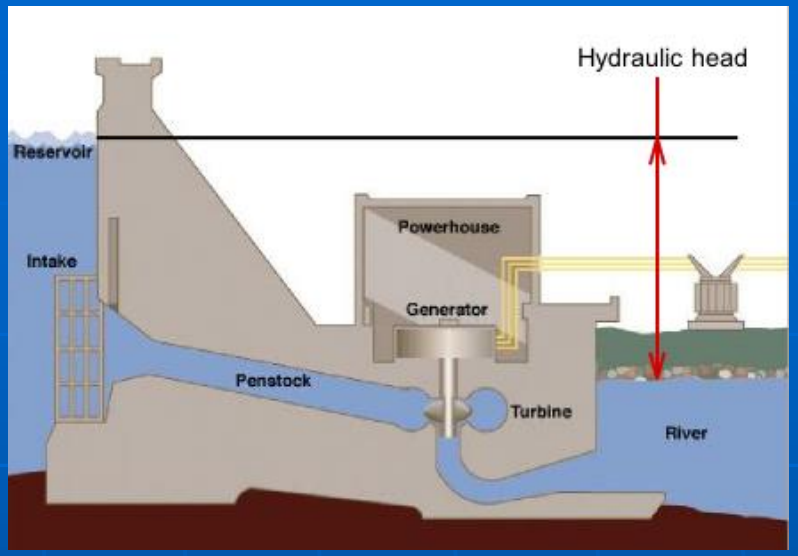
Environmental indicators 4 &5: Water quality & Soil Quality

- Data needed: Contaminant discharges into liquid effluents from energy systems
- Data needed: Concentration of contaminants from energy systems in soil

Environmental Regulations: Monitoring and enforcement of environmental standards and protection measures to control and reduce local air pollution, waste / waste water discharges, soil contamination, noise, and/or other impacts, as applicable



Source: Appalachian Voices Website: appvoices.org/coalash/power-plant-waste



Assessment and monitoring of environmental concerns in water quality and hydro power production

- e.g. water quality variation resulting from seasonal stratification of water in large reservoirs ;
- eutrophication of reservoirs resulting from wastewate, phosphorus containing detergents, fertilizers, etc)
- other accidental pollution of reservoirs and run-off water;

- Impacts are typically site and project specific

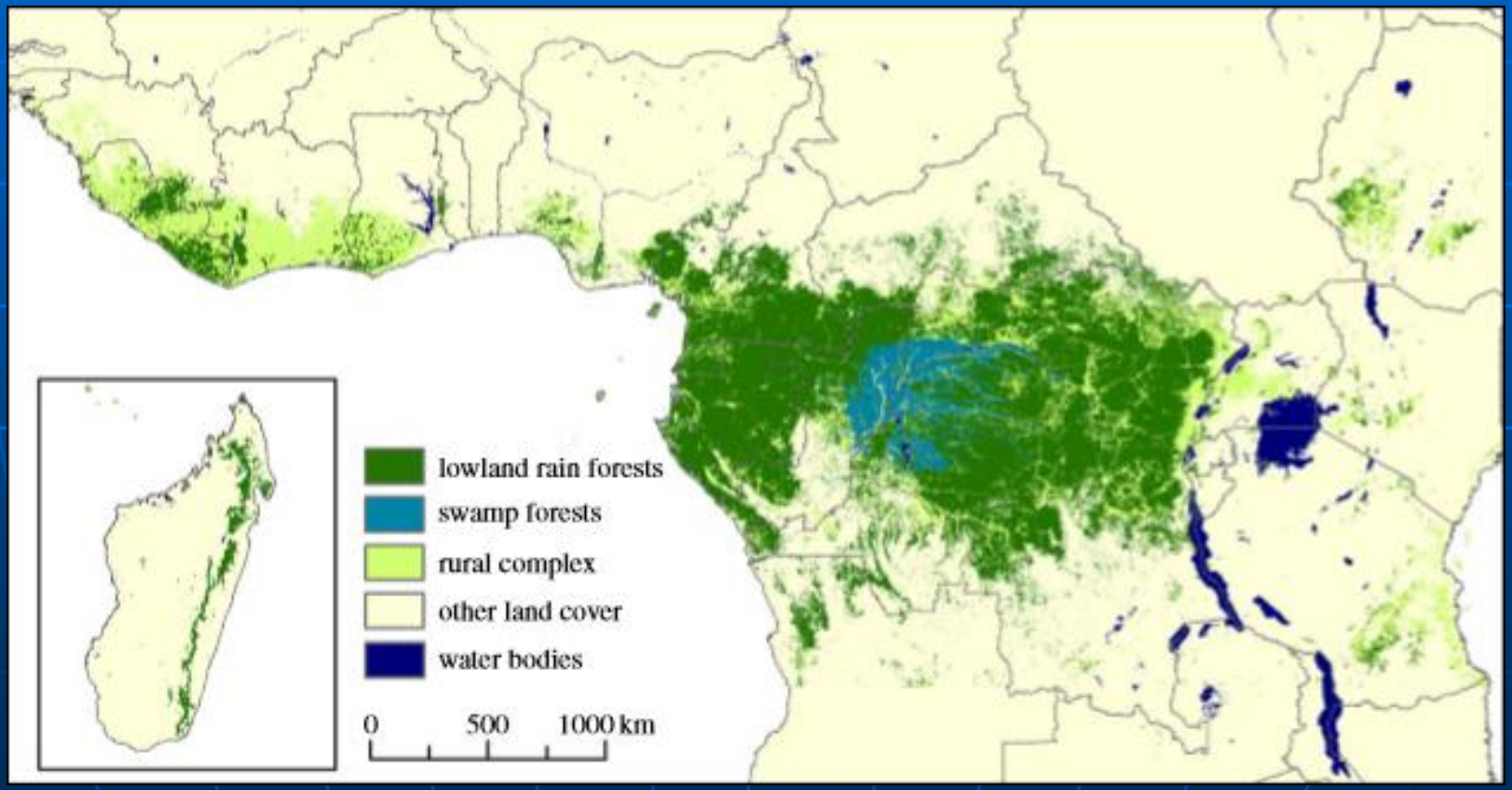
Source of graph: wikimedia – public domain

Interim conclusion/recommendations:

- Environmental data on water or soil pollution will depend on the respective national/local energy system, … on the applicable environmental laws, regulations and standards and … on capacities, policies and measures to ensure or enforce compliance;
- Inter-Ministerial/inter-institutional cooperation needed;
- Adequate budgets, equipment and operational training/capacity building needed;

Environmental indicator 6: Forest and deforestation

Data needed: Rate of deforestation attributed to energy use



Source: Philippe Mayaux et al (2013), State and evolution of African rainforests between 1990 and 2010, in Philosophical Transactions of the Royal Society B , rstb.royalsocietypublishing.org

Gross and net deforestation areas and annual rates measured from the sample of satellite images (areas in 1000 ha) for three regions, 1990-2000 and 2000-2010 – Mayaux et al. (2013)

	1990–2000		1990–2000		2000–2010		2000-2010	
	gross de-forestation	annual rate (%)	net de-forestation	annual rate (%)	Gross de-forestation	annual rate (%)	net de-forestation	annual rate (%)
Central Africa (n=173)	345.9 ± 54	0.19	285.4 ± 36.5	0.16	187.6 ± 22.2	0.11	181.5 ± 39.8	0.1
West Africa (n=67)	278.7 ± 77.9	1.09	233.5 ± 108.3	0.91	82.1 ± 14.1	0.35	70.4 ± 23.9	0.3
Madagascar (n=16)	75.8 ± 25.8	1.69	728 ± 32.8	1.63	40.5 ± 18.2	1.08	36.4 ± 24.8	0.97
total three regions	700.4	0.33	591.9	0.28	310.2	0.15	288.3	0.14

Source: Philippe Mayaux et al (2013), State and evolution of African rainforests between 1990 and 2010, in Philosophical Transactions of the Royal Society B , rstb.royalsocietypublishing.org

Interim conclusion/recommendations:

- The rate of de-forestation in sub-Saharan Africa is high, but it shows a (long-term regional) trend of declining;
- De-forestation has many causes, with "harvesting of fuel wood" only being one of them;
- De-forestation is observed to be faster in more densely populated peripheral (rural) areas, and in zones that are geographically close to (commercial) agricultural production and farming;

Environmental Indicators 9&10: Solid waste – management of radioactive waste

Data needed:

- Solid radioactive waste generation per energy produced;
- Ratio of solid radioactive waste awaiting disposal to total generated solid radioactive waste

Notes:

- Currently no electricity production from nuclear in sub-Saharan African countries (except for South Africa)
- Future nuclear power generation planned in Kenya and Sudan;

Thank you

Further information:

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