Country Lighting Assessment

Peru

The transition to energy efficient lighting in the residential, commercial, industrial and outdoor sectors for all major lamp types would result in the following benefits:

Financial Benefits

272.2 million USD
annual savings

3 months
payback period

Energy Saving Benefits

Potential Savings:

1.9 TWh in annual electricity consumption

5.6% of total national electricity consumption

37.4% of electricity consumption for lighting

Equivalent to:

Power output of 3 medium (100MW) power plants

166.4 kilotonnes of crude oil

Climate Change Mitigation Benefits

477.6 kilotonnes annual reduction of carbon dioxide emissions

Equivalent to 0.1 million mid-size cars off the road
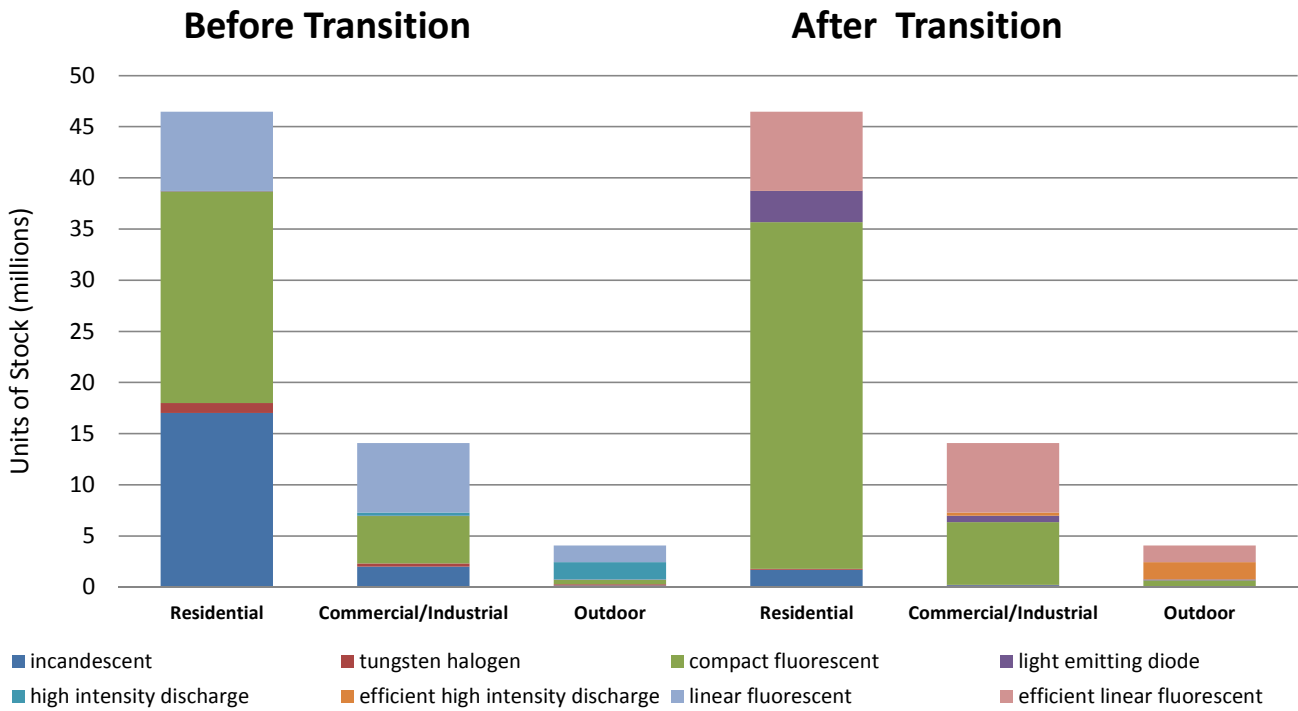
Other Environmental Benefits

6.4 kilograms of mercury emissions avoided

327.0 tonnes of sulphur dioxide emissions avoided
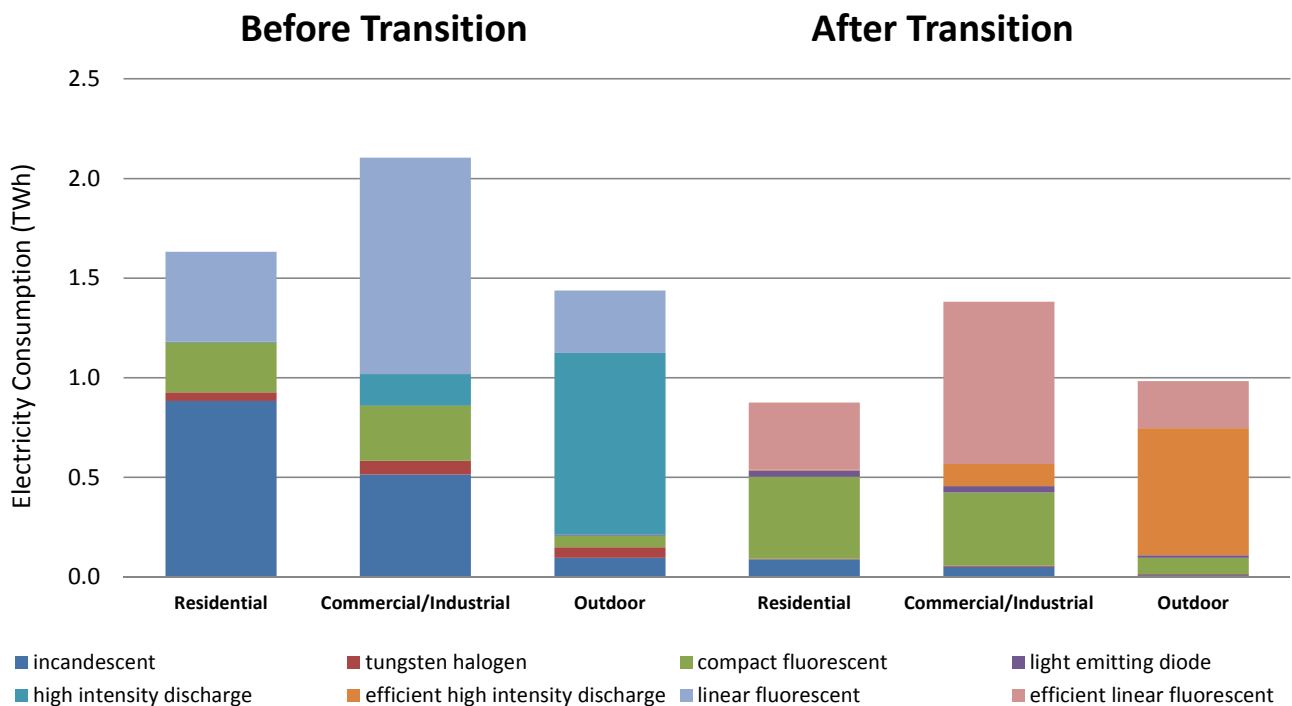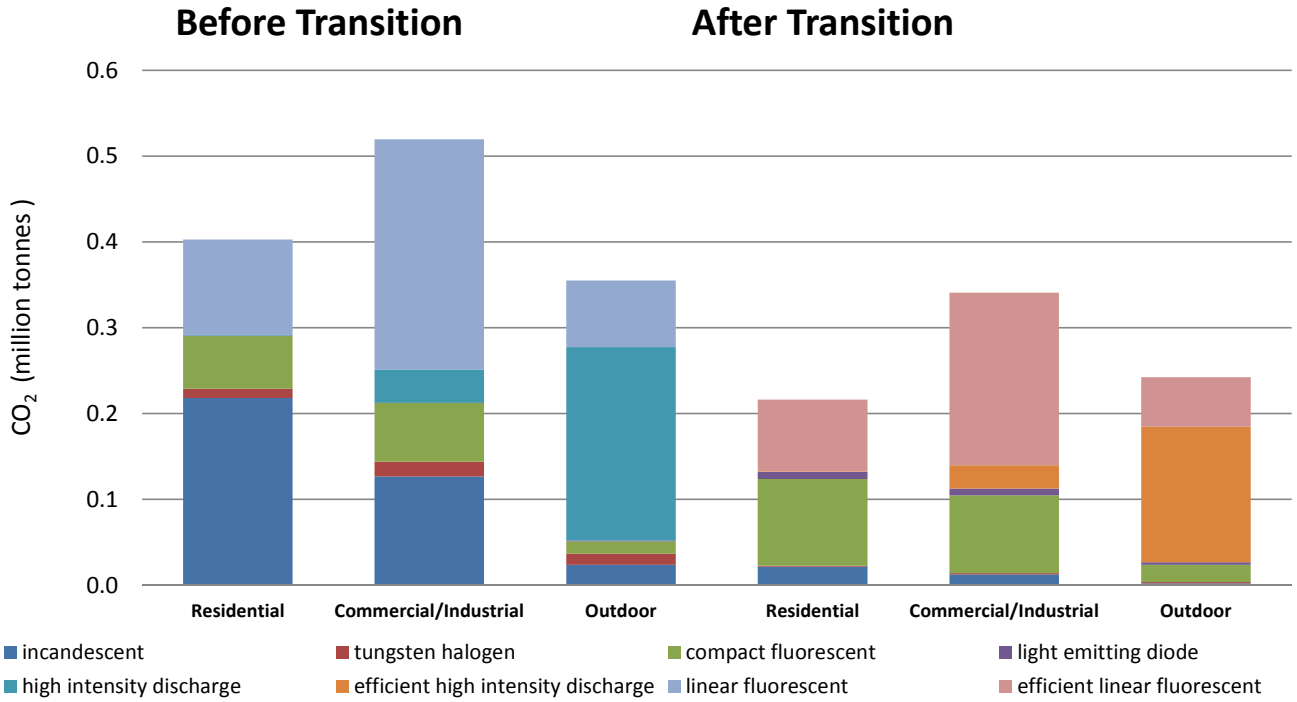
177.0 tonnes of nitrous oxide emissions avoided

2010 Stock Estimate, version 1.1

Installed Stock of Lamps (by sector, by lamp type)

Before Transition

After Transition

Units of Stock (millions)

- incandescent
- tungsten halogen
- compact fluorescent
- light emitting diode
- high intensity discharge
- efficient high intensity discharge
- linear fluorescent
- efficient linear fluorescent

Total Electricity Consumption (by sector, by lamp type)

Before Transition

After Transition

Electricity Consumption (TWh)

- incandescent
- tungsten halogen
- compact fluorescent
- light emitting diode
- high intensity discharge
- efficient high intensity discharge
- linear fluorescent
- efficient linear fluorescent

2010 Stock Estimate, version 1.1

CO$_2$ Emissions (by sector, by lamp type)

Before Transition   After Transition

CO$_2$ (million tonnes)

- incandescent
- tungsten halogen
- compact fluorescent
- light emitting diode
- high intensity discharge
- efficient high intensity discharge
- linear fluorescent
- efficient linear fluorescent

Residential   Commercial/Industrial   Outdoor   Residential   Commercial/Industrial   Outdoor

Cost Reduction (by source) [1]

Cost Reduction (million USD)

51
3
756

63
2
473

Before Transition   After Transition

- electricity cost
- labour cost
- lamp cost
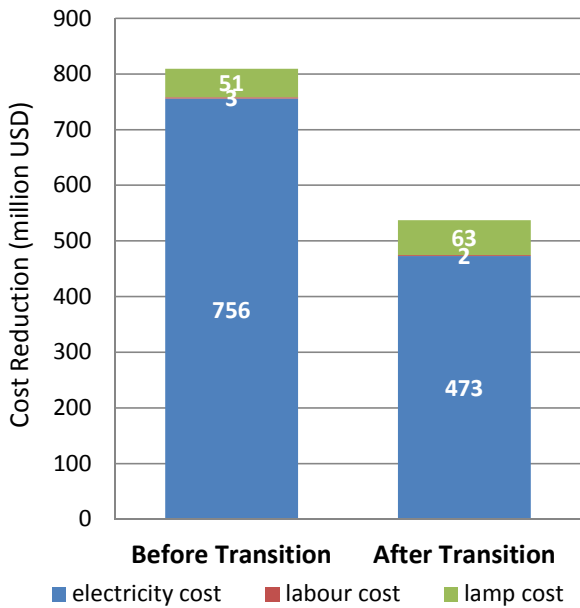
Mercury Emissions (by source) [2]

Mercury (kilograms)

4.1
14.5

3.1
9.1

Before Transition   After Transition

- compact fluorescent and linear fluorescent lamps
- coal-fired power plant
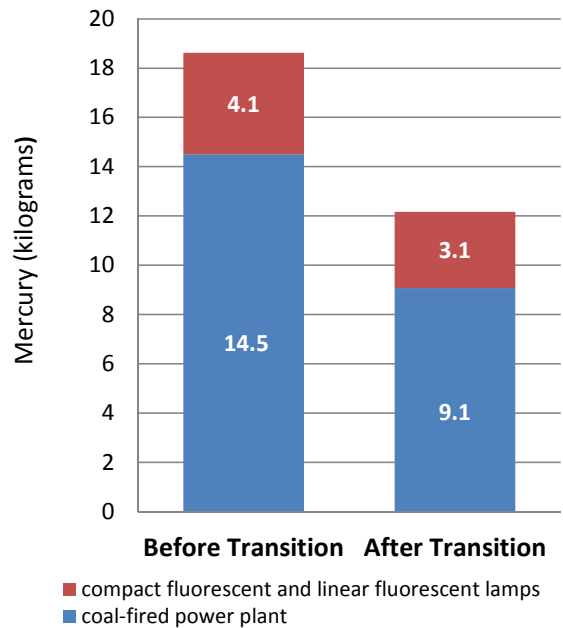
Notes:
1. Represents the annual operating cost for all lamps, including installation, maintenance, replacement and electricity costs.
2. Coal-fired power plant emissions and mercury released when recycling compact fluorescent and linear fluorescent lamps.

Country Specific Data and Input Assumptions

General Information

Population	29.1 million
Area (km^2)	1.3 million
GDP per capita	5,401 USD/person
Electrification level	85.7%

Electricity Market

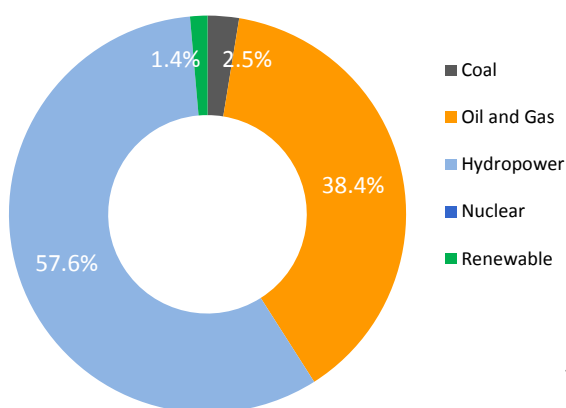|	
Installed generating capacity	6.0 GW
Total electricity production	38 TWh
Total electricity consumption	35 TWh
GDP/unit electricity consumption	4.5 USD/kWh
Share of lighting	14.9%

Average Electricity Prices

Residential	0.146 USD/kWh
Commercial/Industrial	0.146 USD/kWh
Outdoor	0.146 USD/kWh
Annual coal power plant production	957 GWh

CO$_2$ Emissions Data

Total CO$_2$ emissions	47 Mt
CO$_2$ emission factor	247 g/kWh
CO$_2$ trading price	17.5 USD/tonne
CO$_2$ trading value	8.3 million USD

Air and Ground Pollutants

Mercury emissions from coal combustion	0.11 mg/kWh
SO$_2$ emissions from coal combustion	6.63 g/kWh
NO$_x$ emissions from coal combustion	3.59 g/kWh
Mercury released during compact fluorescent and linear fluorescent lamp recycling	11.0%

Mercury Content per Lamp

Compact fluorescent	2.5 mg/lamp
Linear fluorescent	10 mg/lamp
Efficient linear fluorescent	5 mg/lamp

Electricity Production Mix

- Coal — 2.5%
- Oil and Gas — 38.4%
- Hydropower — 57.6%
- Nuclear
- Renewable — 1.4%

Lamp Wattage (by sector, by type)

residential   commercial/industrial   outdoor
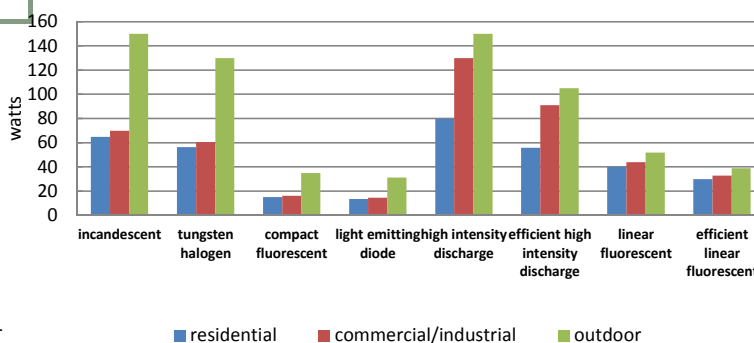
Lamp Average Life (by sector, by type)

residential   commercial/industrial   outdoor
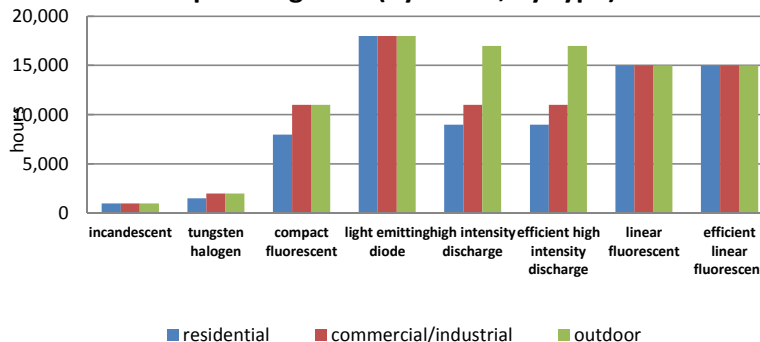
Data Sources

General Information

- **Population** data (data for 2010) comes from the World Bank.
- **Area** data comes from the United States Central Intelligence Agency (US CIA), 2012.
- **GDP per capita** (current USD) is calculated using GDP/population. GDP in current US $ (data for 2010) is taken from the World Bank. For countries without GDP value in 2010, an estimate is forecasted based on the trend from the previous five years (2005 through 2009). For countries without any GDP value from the World Bank, the US CIA data is used.
- **Electrification level** data is taken from the World Bank (data for 2009). For countries without the data from World Bank, data from Buckminster and World Bank's Databank are crosschecked and cited.

Electricity Data

- **Installed generating capacity** (estimates for 2010) is cited here, forecasted based on trend from the U.S Energy Information Administration (EIA) (2001 through 2005).
- **Total electricity production and consumption** (data for 2010) are sourced from the World Bank. For countries without total electricity production and consumption value in 2010, an estimate is forecasted based on the trend from the previous five years (2005 through 2009). For countries without any value from the World Bank, the US CIA data for electricity production and consumption are used.
- **Average electricity price** in residential and professional sector cited was provided by the International Energy Agency (IEA, data covers OECD countries in 2010). Electricity price in outdoor sector is set the same as electricity price in professional sector. For other countries where the IEA did not have an electricity price, market research was conducted to collect the information. The reference year (from 2002 to 2012) varies due to the quality of data available. (NOTE: due to the adjustment of electricity price in individual country, the data shown here might not represent the most accurate value.)
- **Electricity production mix** data shown here comes from the World Bank (data for 2009). Five different sources are differentiate: coal, oil and gas (calculated using the Electricity Production from coal, oil and gas source minus the electricity production from coal source), hydroelectric, nuclear, renewable (excluding hydro electric). For country without data from the World Bank, the data is generated through crosscheck of US CIA and US EIA.
- **GDP/unit electricity consumption, share of lighting** and **annual coal power plant production** are calculated for each country from the above data.

CO_2 emissions Data

- **Total CO_2 emission** (estimate for 2010) is prepared based on the World Bank (2004 -2008).
- **CO_2 emission factor** is taken from the IEA (estimates for 2010 covering 138 countries based on data from 2005 to 2009). For countries without CO_2 emission factors from the IEA, findings from a study "2010 Environment Performance Index" is used. For countries without CO_2 emission factor from either of these two sources, the value is calculated based on countries geographically nearby and then corrected using the electricity production mix data.
- **CO_2 trading price** cited represents a global average value for 2010.
- **CO_2 trading value** is calculated for each country.

Air and Ground Pollutants
- For countries with electricity production from coal source:
  -**Mercury emissions from coal combustion** (mg/kWh) are set based on UNEP toolbox global average.
  -**SO2 emissions from coal combustion** (g/kWh) are set based on a research paper.
  -**NOx emissions from coal combustion** (g/kWh) are set based on a research paper.
- **Mercury released during compact fluorescent and linear fluorescent lamp recycling** and **mercury content per lamp** were developed based on industry consultations.

Lighting Data
- Estimates of the installed stock of lamps were provided by OSRAM and Philips for all lamp types on a regional basis for the year 2010.
- Estimates of the typical lamp wattage, lamp price, operating hours, lamp lifetime, installation labour, and other factors were developed for countries based on industry consultations, internet research and country feedback.
- Several countries provided estimates of their own national markets based on their own research and available experts.
- For certain countries without domestic manufacturing of lamps, imports and exports of lamps from the United Nations' Comtrade database were used to calculate six years (2005 through 2010) of net imported lamps. Using these shipment data and taking into account typical operating hours and lamp lifetimes, a time-series stock model was developed and the installed stock of lamps for each country was estimated.

Others
- The average annual household electricity consumption is assumed to be 2000 kWh/year for countries with access to electricity (electrification rate) less than 60%.
- TWh of electricity savings are converted and reported in crude oil energy equivalents according to the conversion factor of 11.63 MWh/toe, or 1 TWh = 86 ktoe.
- A plant factor of 85% is assumed when converting the electricity savings to power plant electricity production equivalent.
- The annual CO_2 emission for a car are based on a mid-size car with a CO_2 emission factor of 160 g CO_2/km and a yearly distance of 25,000 km; emitting 4 tons of CO_2

If you have any comments or better data sources you can offer, please contact us.

For information on the en.lighten initiative visit: http://www.enlighten-initiative.org/