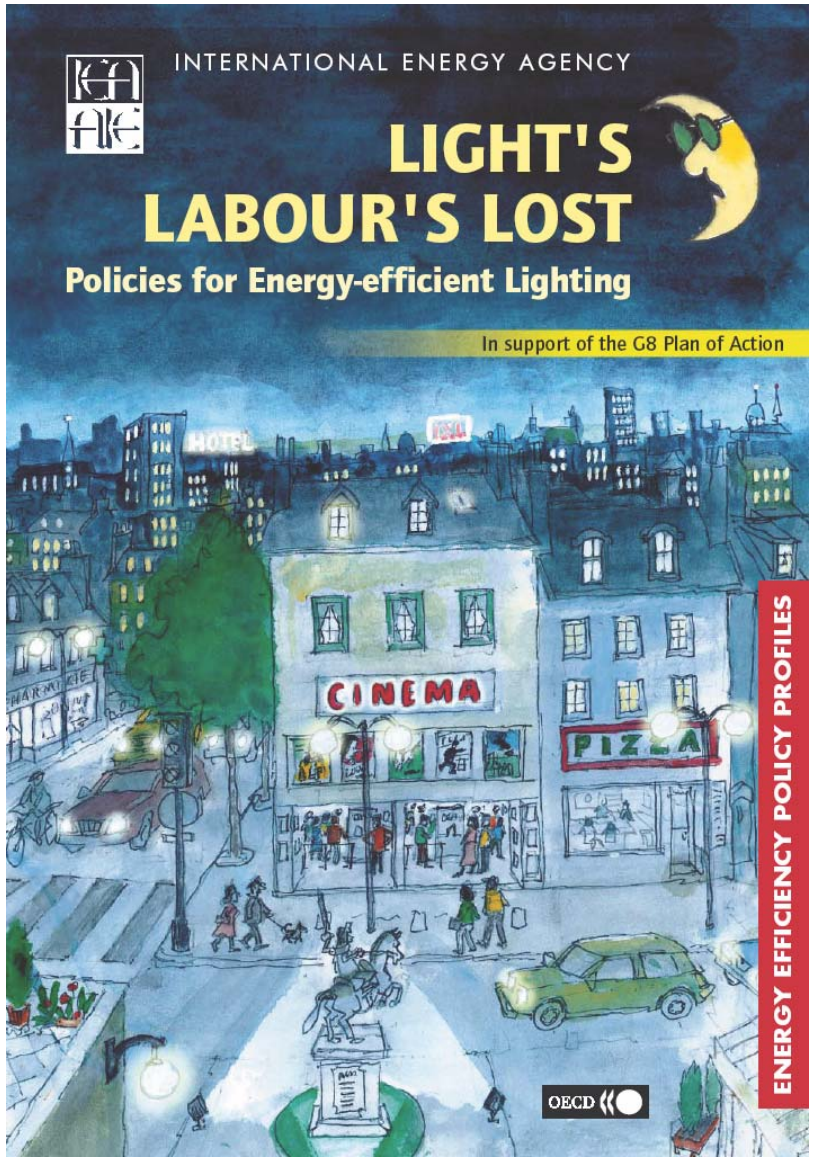
Light's Labour's Lost: Policies for Energy-efficient Lighting



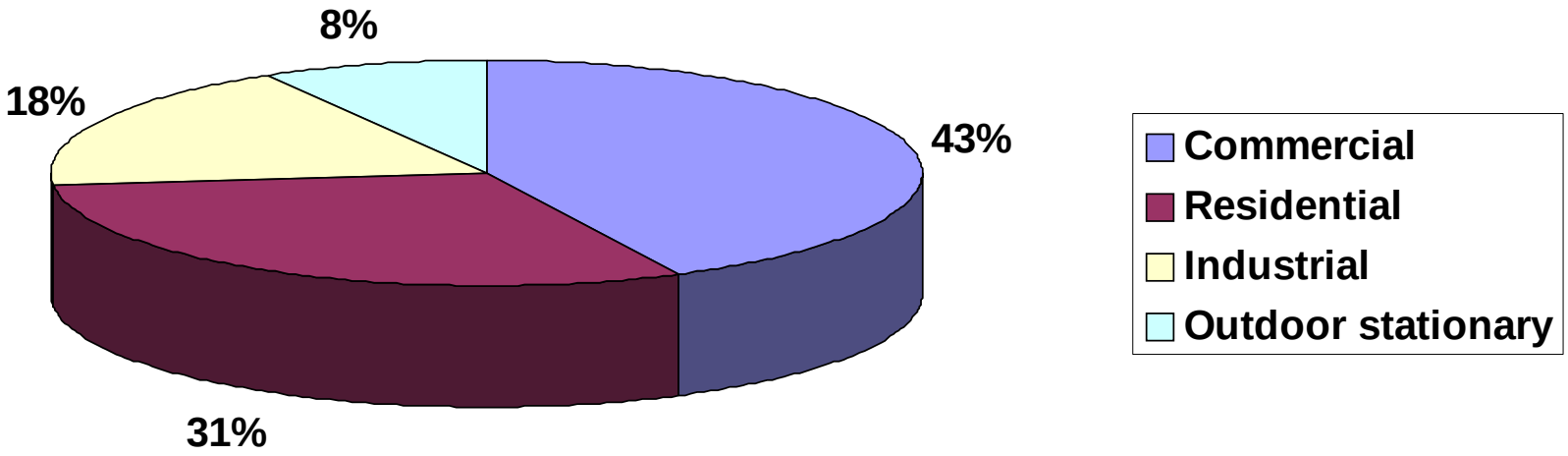
How important is lighting?

- 2650 TWh of electricity consumption
- some 19% of global electricity use (15-17% greater than nuclear or hydro power)
- equivalent to production of all gas-fired power generation, or 1265 power plants

Lighting CO_2 emissions in 2005

- All lighting = 1889 $MtCO_2$
  - Grid based = 1528 $MtCO_2$
  - Fuel-based lighting = 200 $MtCO_2$
  - Vehicle lighting = 161 $MtCO_2$
- Equivalent to 70% of world passenger vehicle emissions

Lighting electricity consumption shares by sector in 2005



The cost of lighting in 2005

- Total cost of lighting is US$460 billion per annum
- Equivalent to >1% of global GDP or the total GDP of the Former Soviet Union
- Two thirds of the cost is for the energy used

Cost of residential lighting in 2005

- Total cost of residential electric lighting is US$136 billion
- Equivalent to US$7.1 per Mlm-hr
- The cost of electricity is ¾ of the total
- Most energy is for incandescent lighting but this only provides 44% of the delivered light in this sector

Artificial source-lumens: residential sector in 2005

- Global average consumption of 3 Mega-lumens of residential electric-light per capita/year
- Average North American uses 13.2 Mega-lm-hrs; average Chinese 1.5 Mega-lm-hrs
- But that's still 300 times average artificial per capita light use in England in C19th
- Yet average Japanese uses 18.5 Mlmh and the average European or Australian uses 2.7Mlmh
- Global light consumption = 19.2 Peta-lm-hrs in 2005

"These lovely lamps, these windows of the soul."

- Incandescent
- Fluorescent
- HID






Large differences in lamp efficacy

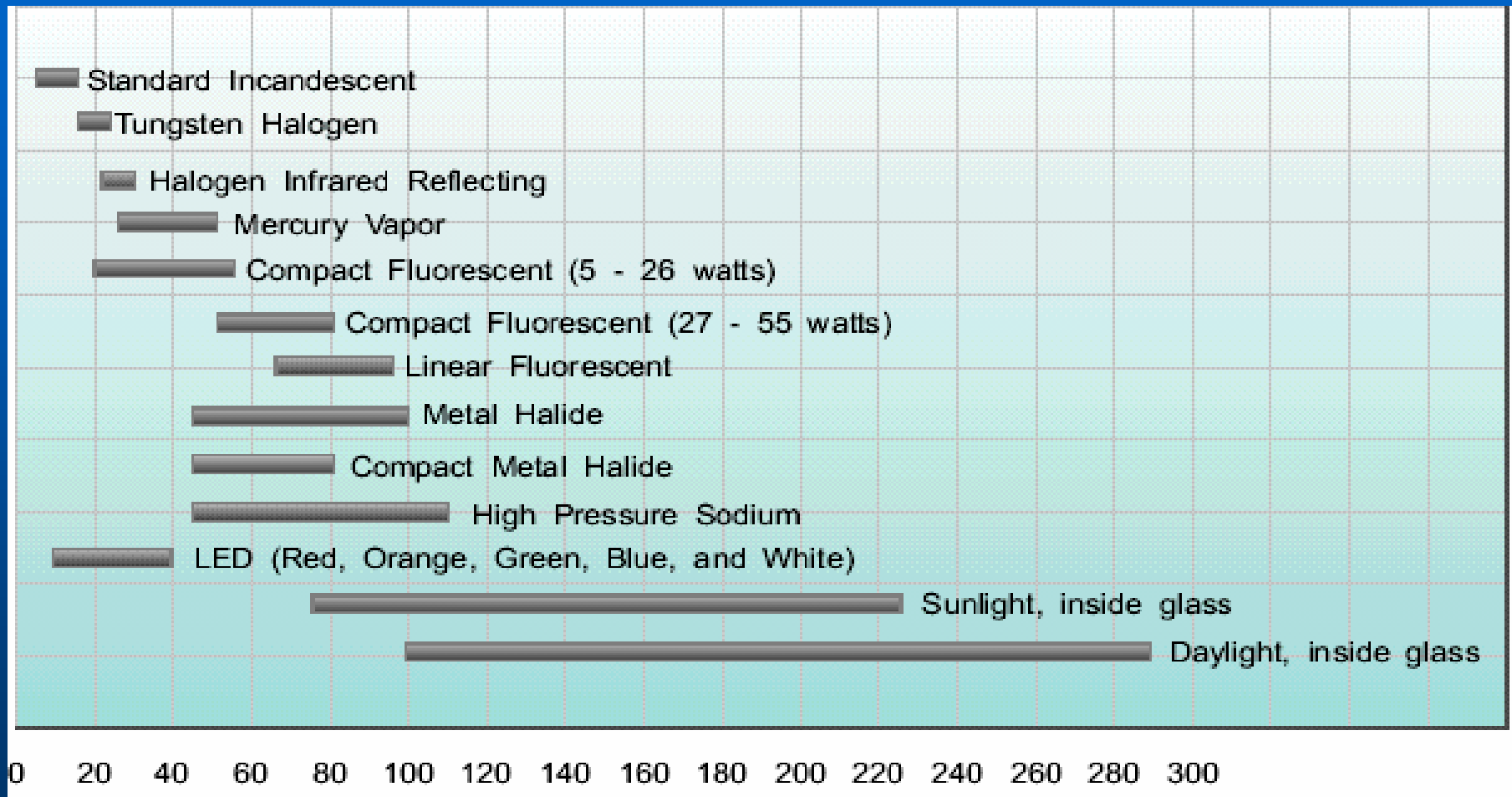
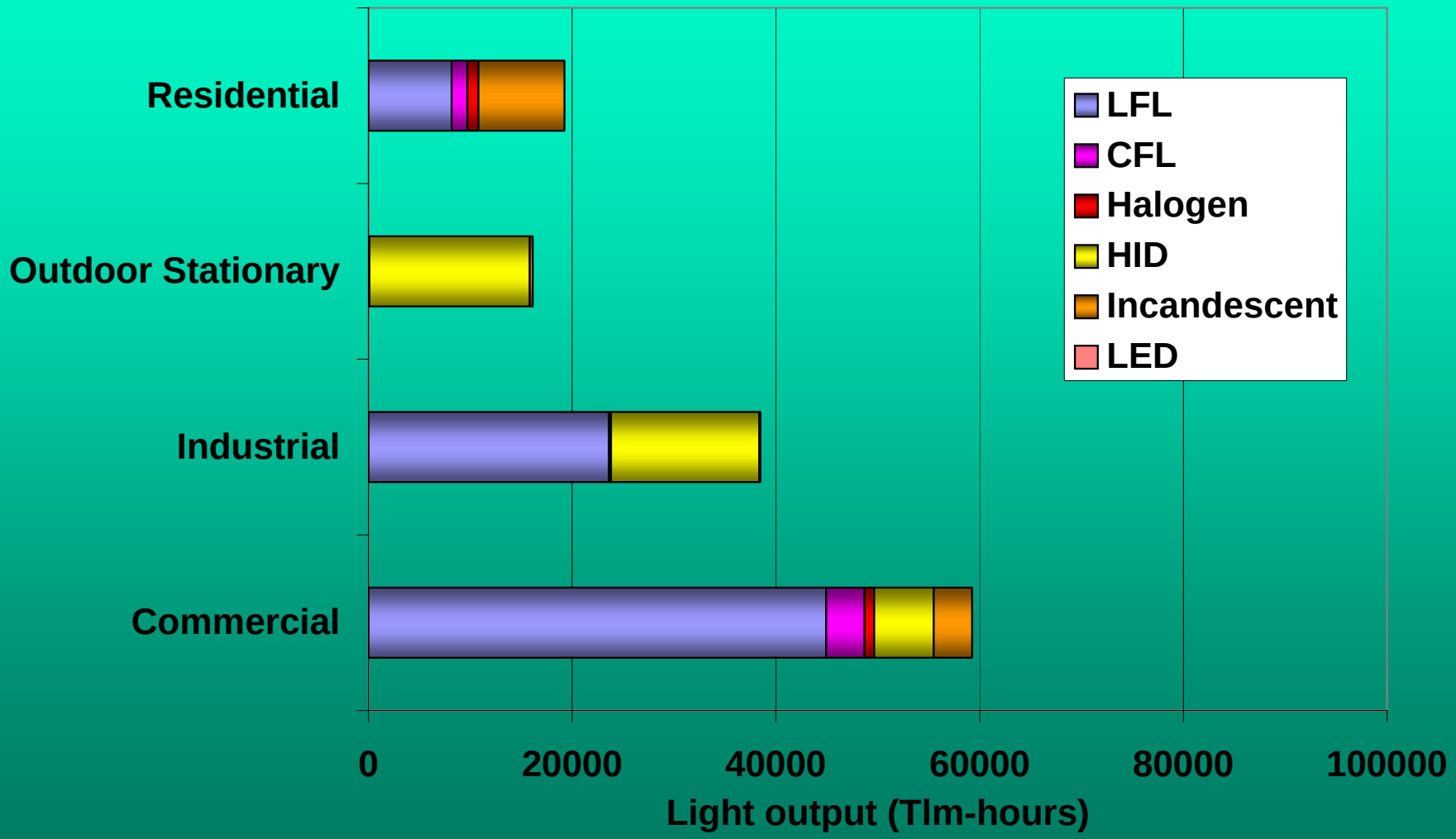


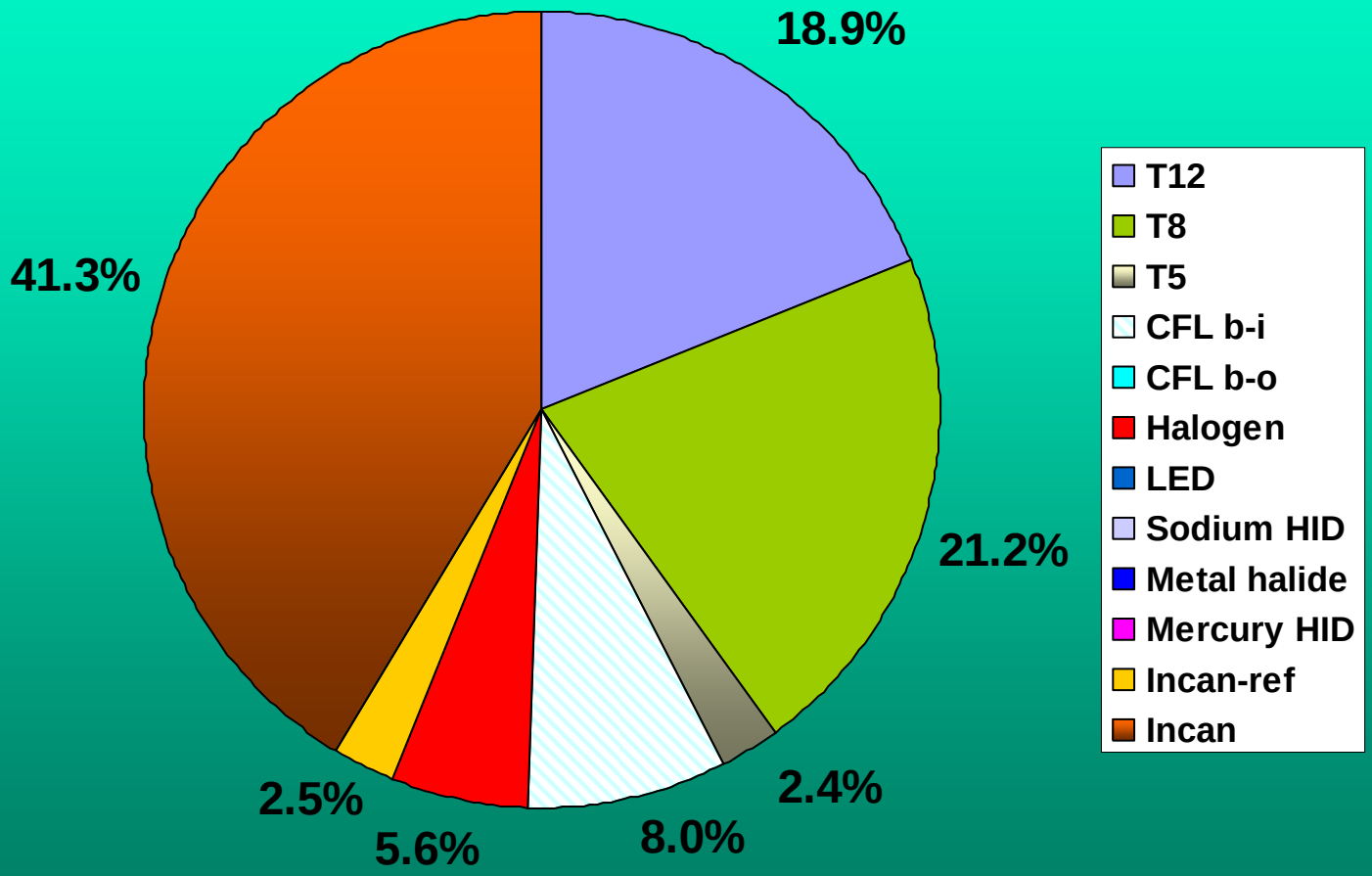
Figure 6-2 – Efficacy Comparison of Light Sources for General Lighting

Ballast watts included for discharge lamps systems. Sunlight and daylight ranges calculated inside of single pane clear glass and high performance glass.

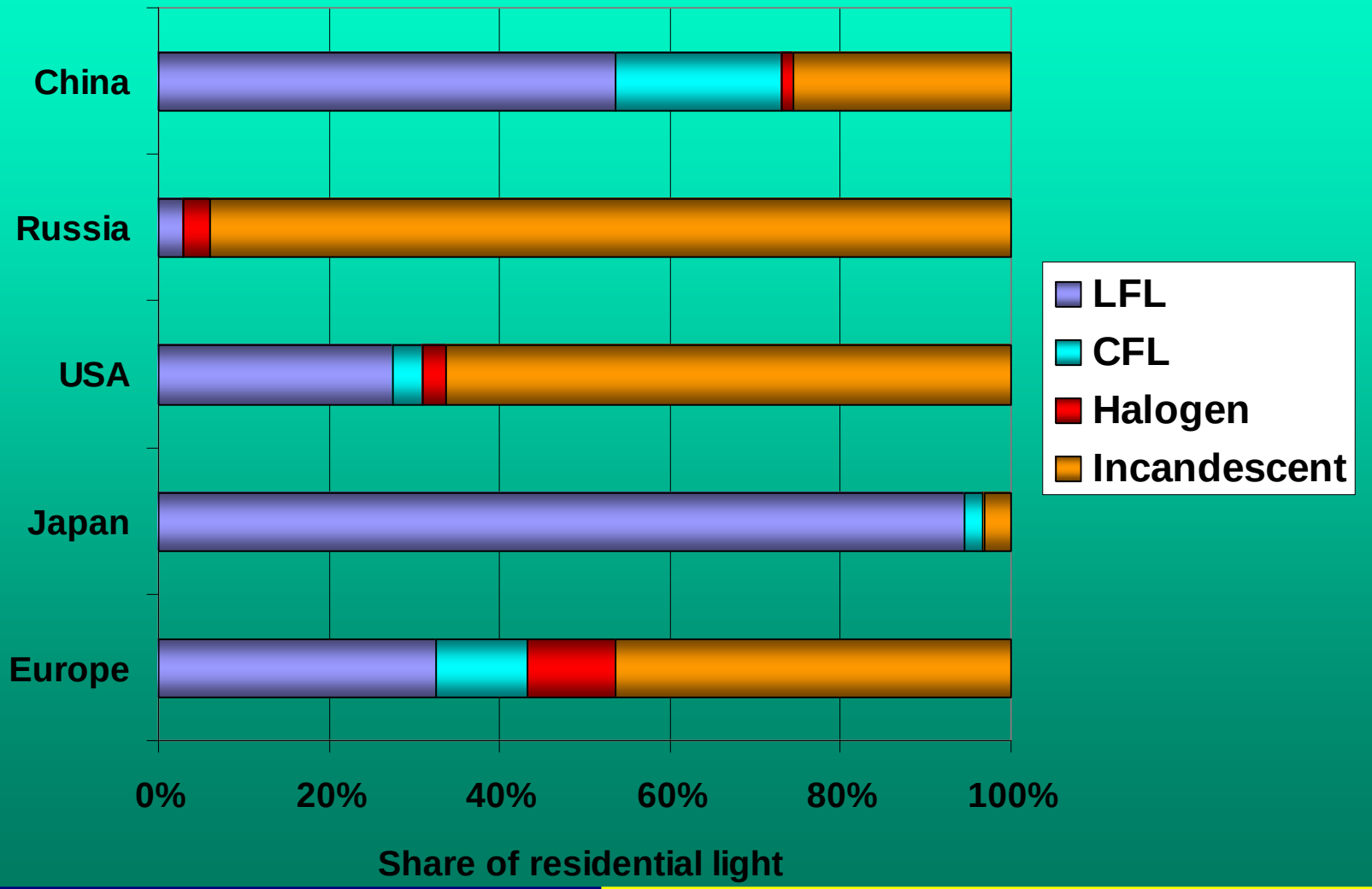
Total delivered light in 2005 (Teralumen hours)



Light output by lamp type in 2005 (global res. total 19.2 Peta-lumen hrs)



Estimated share of res. light provided by major lighting technologies in 2005



Large differences in residential sector efficacy by region

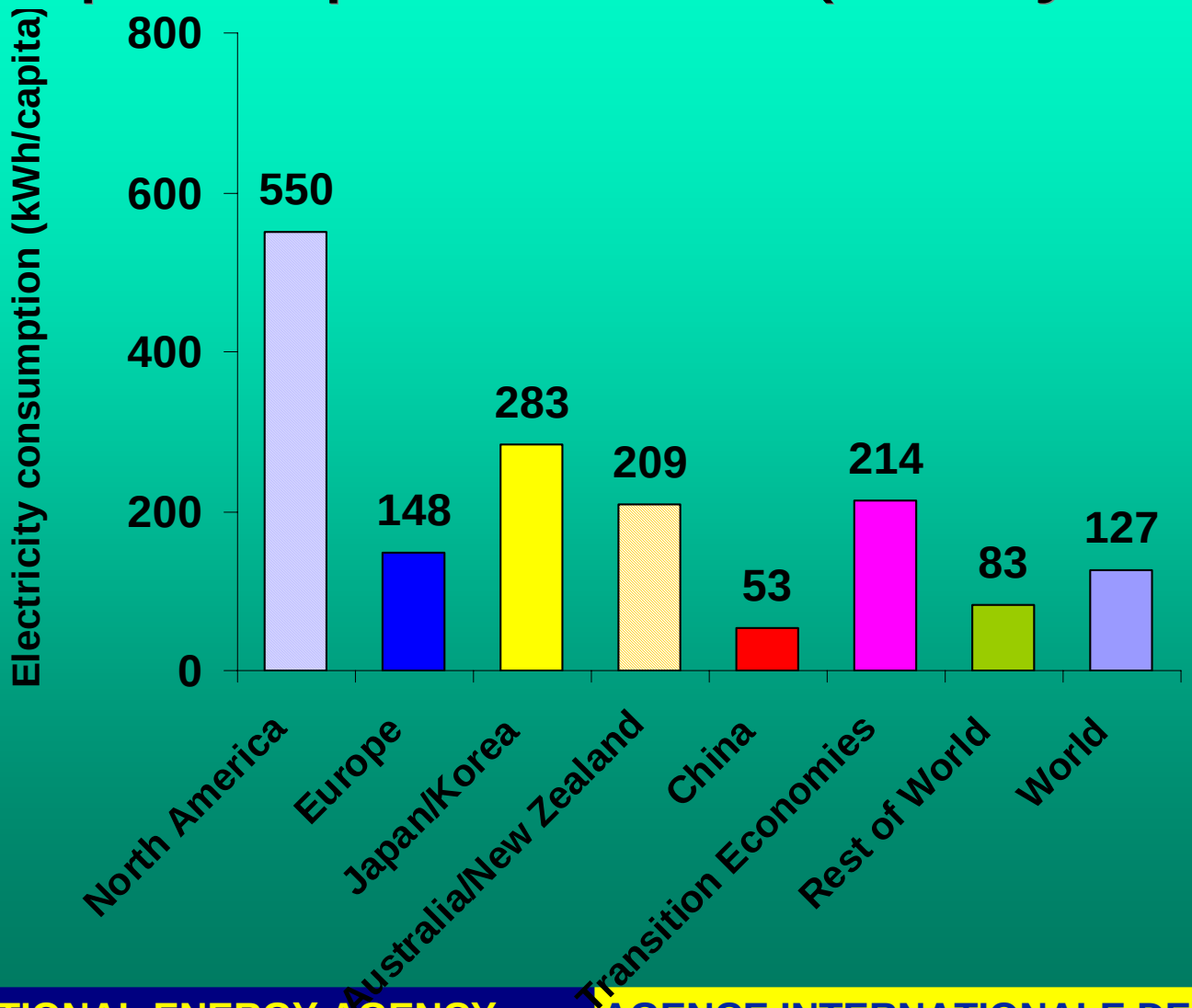
Global average residential electric lighting system efficacy was:

- 23.7 lm/W in 2005
- Greater than a factor of five variation between regions
- 11.5 lm/W in FSU to 64 lm/W in Japan

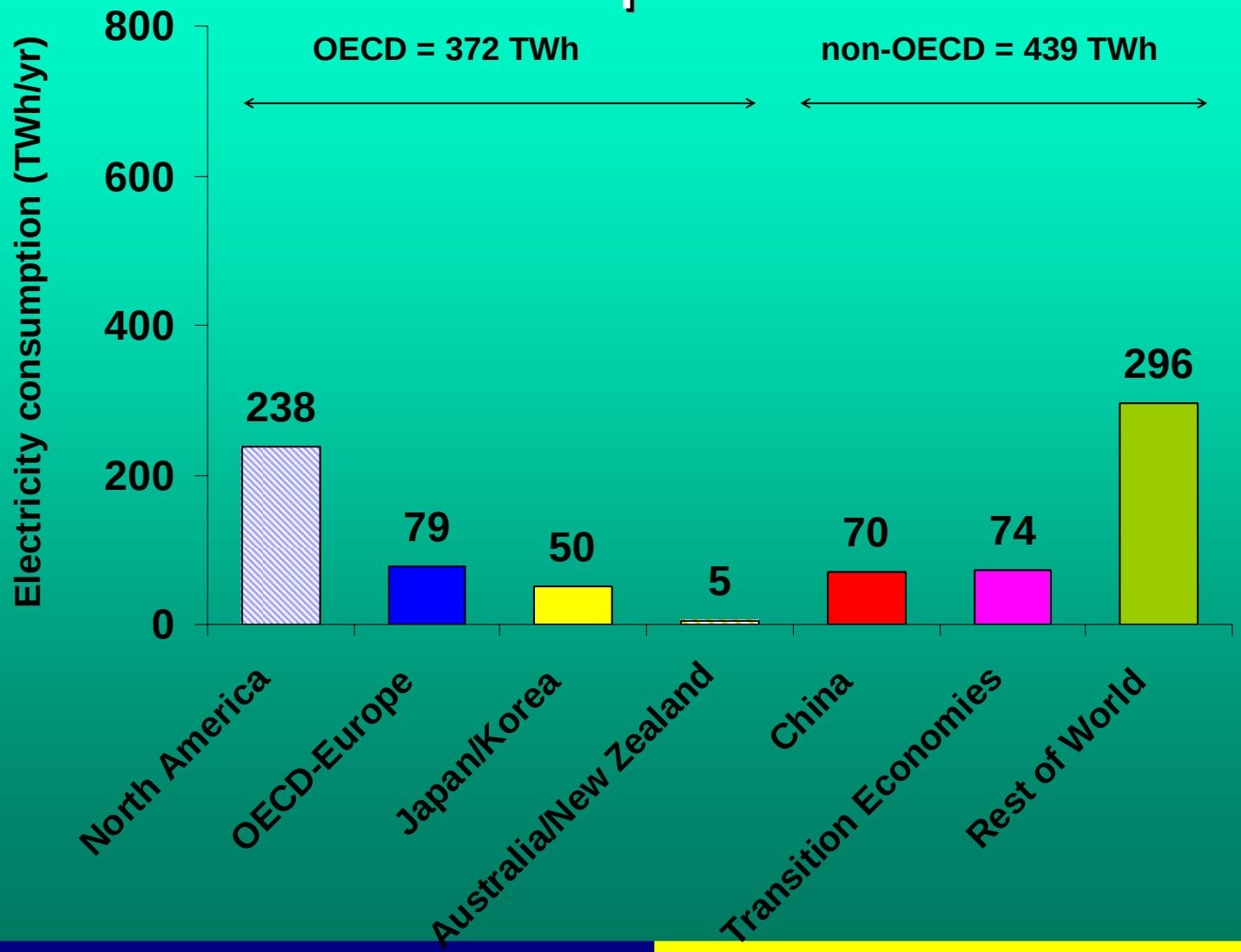
Important differences in OECD

Country	Lighting electricity consumption per household	Lamps per household	Average lamp efficacy	Light consumption per unit floor area	Installed lighting power density	Lighting electricity consumption per unit floor area	Lamp operating time	Household floor area
	kWh/year	Lamps	lm/W	M-lm-hrs/m^2/year	W/m^2	kWh/m^2/yr	hours/day	m^2
UK	720	20.1	25	0.21	14.7	8.6	1.60	84
Sweden	760	40.4	24	0.16	14.0	6.9	1.35	110
Germany	775	30.3	27	0.22	15.6	9.3	1.48	83
Denmark	426	23.7	32	0.10	5.7	3.3	1.59	134
Greece	381	10.4	26	0.09	7.8	3.7	1.30	113
Italy	375	14.0	27	0.09	10.6	4.0	1.03	108
France	465	18.5	18	0.22	16.1	5.7	0.97	81
USA	1946	43.0	18	0.27	21.5	15.1	1.92	132
Japan	939	17.0	64	0.49	8.1	10.0	3.38	94

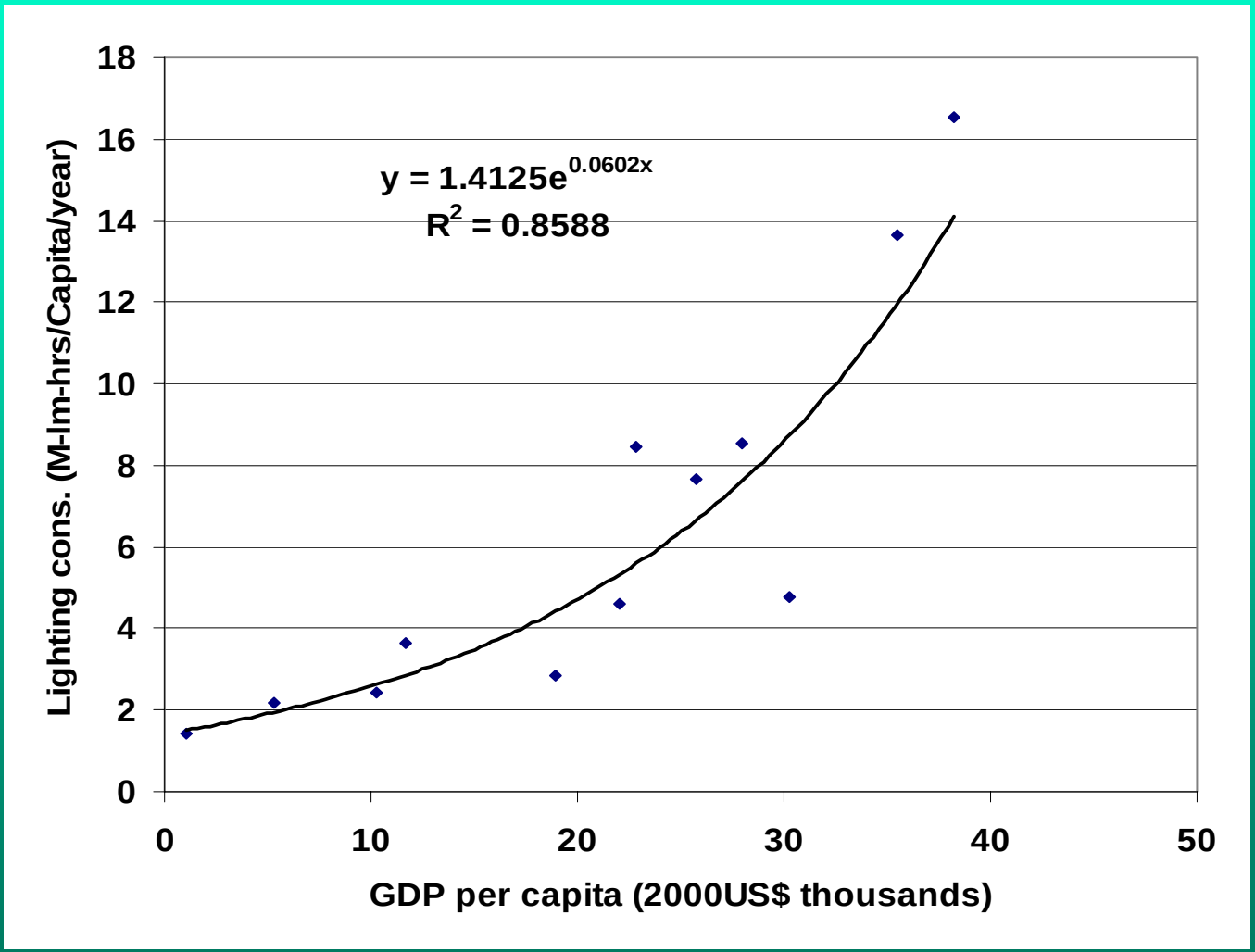
Res. lighting electricity consumption per capita in 2005 (kWh/year)



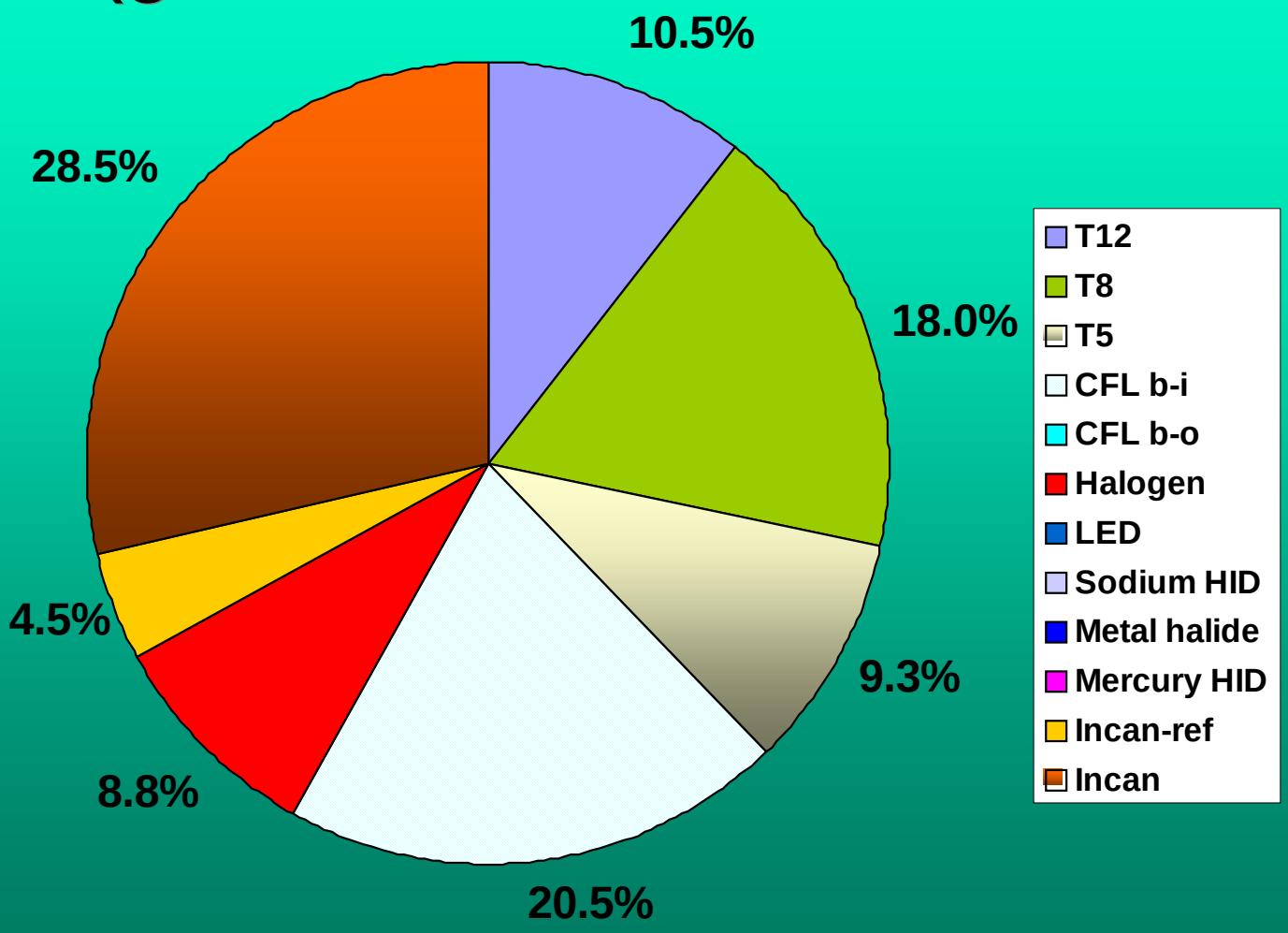
Residential lighting electricity consumption in 2005



Annual average residential electric light consumption vs. GDP/capita



Residential light output by lamp type in 2030 (global total 49 Peta-lumen hrs)



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LIGHT'S LABOUR'S LOST

Policies for Energy-efficient Lighting

Consider use of CFLs in homes

	Incand-escent 	CFL 
Initial cost Efficacy		
Lifespan For 10000 hours use	1000 hours	10000 hours
Electricity cost Cost of lamps	US$75 US$5	US$15 US$10
Total cost of ownership	**US$80**	**US$25**

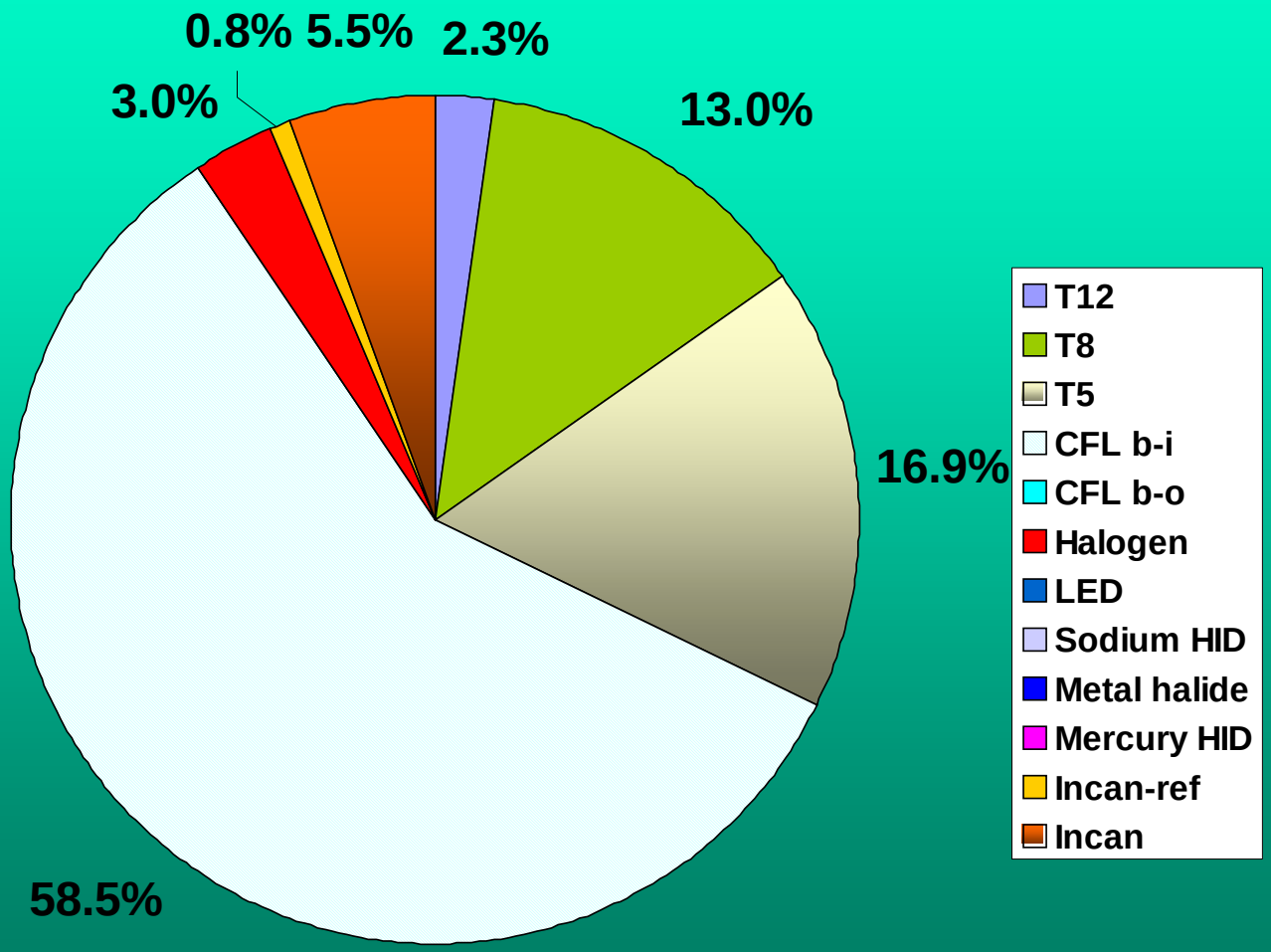
IRR = 186%

Assumptions under least-life cycle cost from 2008 scenario

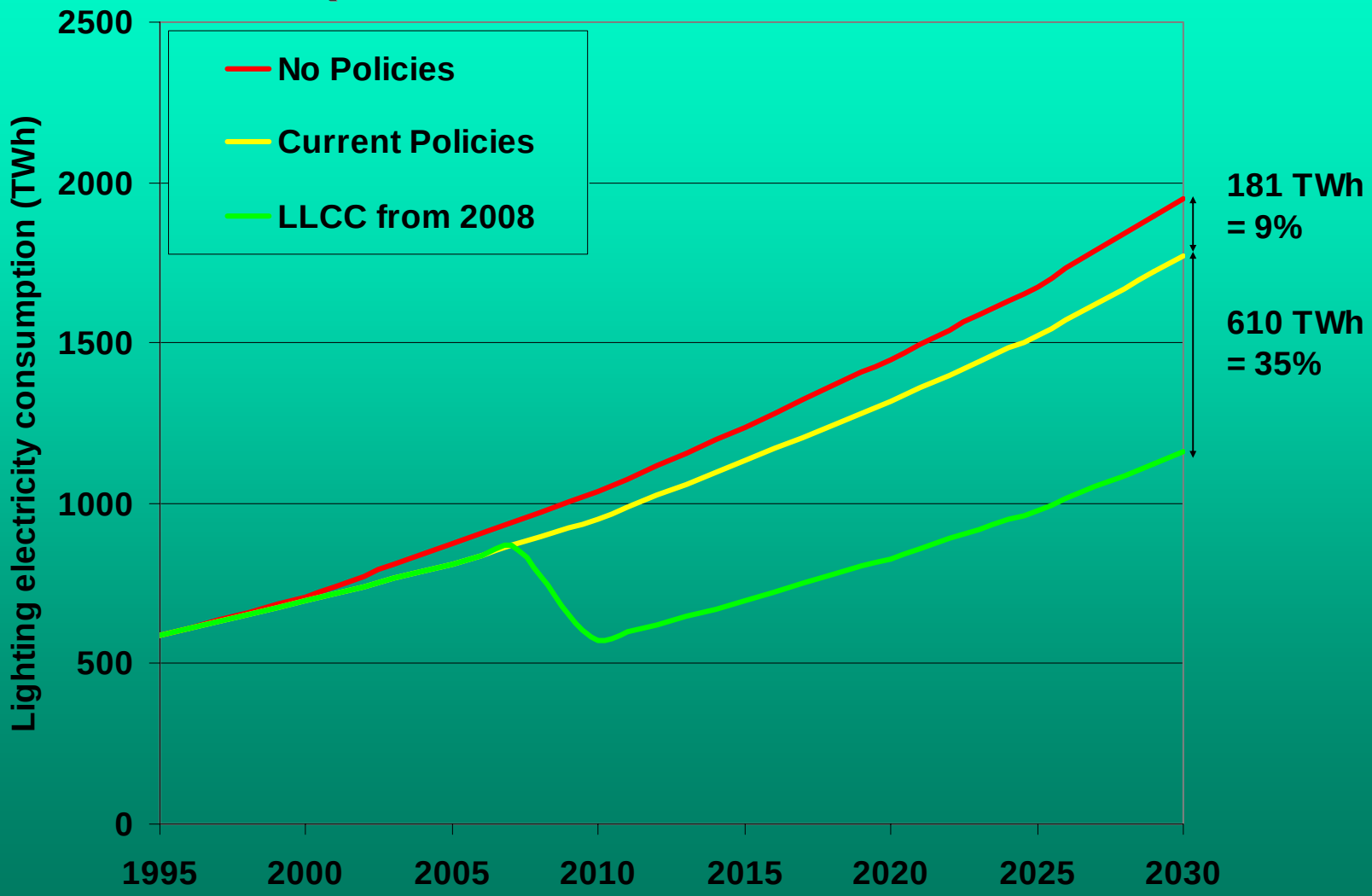
In majority of cases when the operating hours exceed an economic threshold assume:

- CFLs replace incandescent lamps (75% of cases)
- T12s and halo-phosphor T8s are replaced by tri-phosphor T8s and T5s
- Proportion of halogens replaced by LEDs (from medium term onwards)
- Halogen torchieres are phased out
- Electronic ballasts
- In line with natural replacement cycles for lamps, ballasts and fixtures

LLCC Light output by lamp type in 2030 (global res. total 49 Peta-lumen hrs)



Res. energy consumption: no-policies, current-policies and LLCC-scenarios



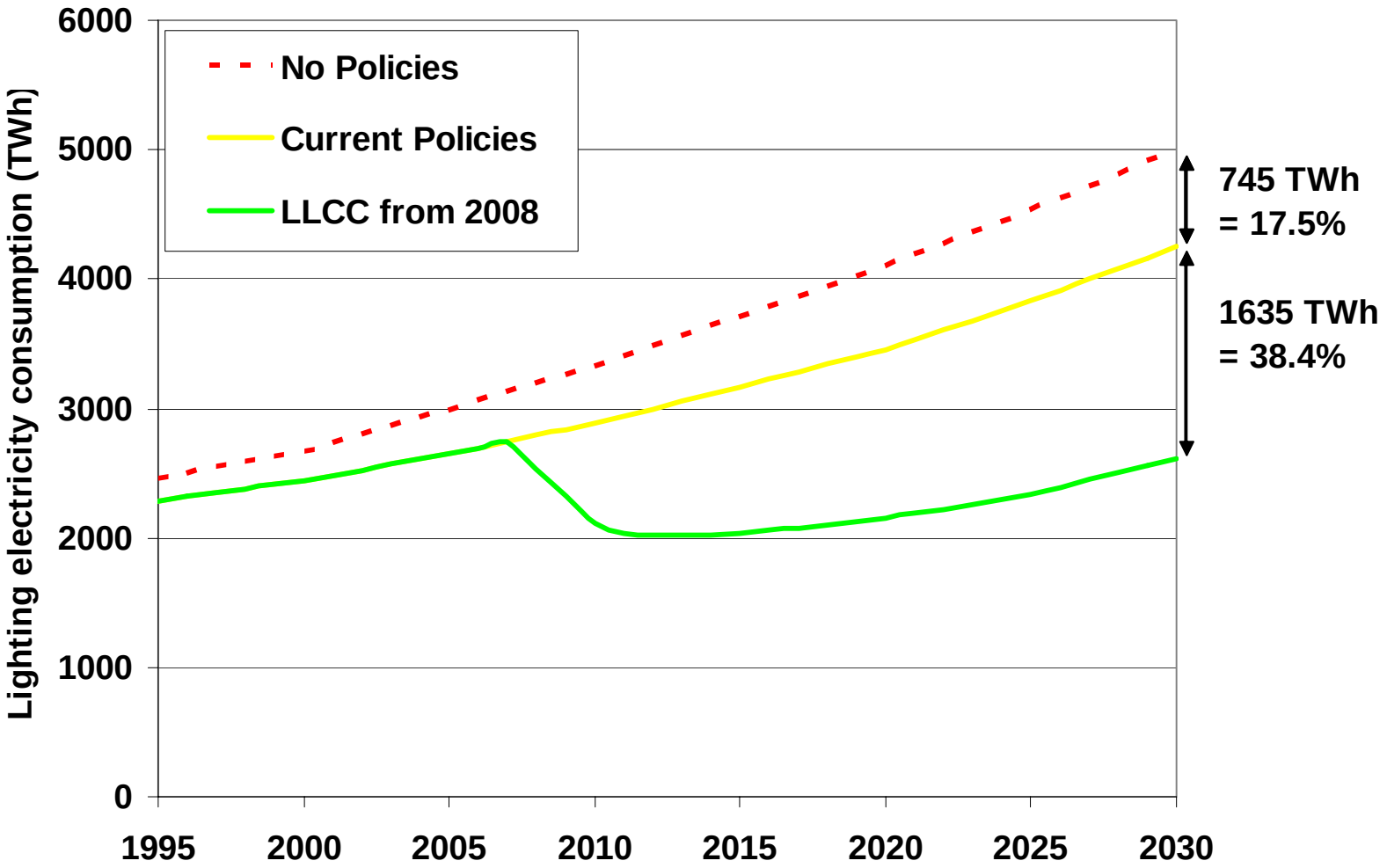
Residential lighting cost savings compared to Current Policies

Benefits from residential *LLCC* scenario compared to *Current Policies* scenario

The least life cycle cost from 2008 results in global savings of:

- US$69 billion and 356 Mt CO_2 in 2030
- US$1.3 trillion and 6.4 Gt CO_2 of cumulative savings to 2030
- Net cost of avoided CO_2 is negative (-US$205/tonne)

Lighting energy consumption scenarios for all grid-electric end-use sectors



Cumulative benefits of the LLCC from 2008 scenario to 2030

- **Avoids 28000 TWh of electricity use (almost 6% of all electricity demand over the same timeframe)**
- **Total costs of lighting are US$2.6 trillion (1000 billion) lower**
- **Avoids 16 Gt of CO_2 emissions**
- **Net cost of avoided CO_2 emissions are negative i.e. -US$161/tonne of CO_2**

Cumulative benefits from phasing-out incandescent lighting

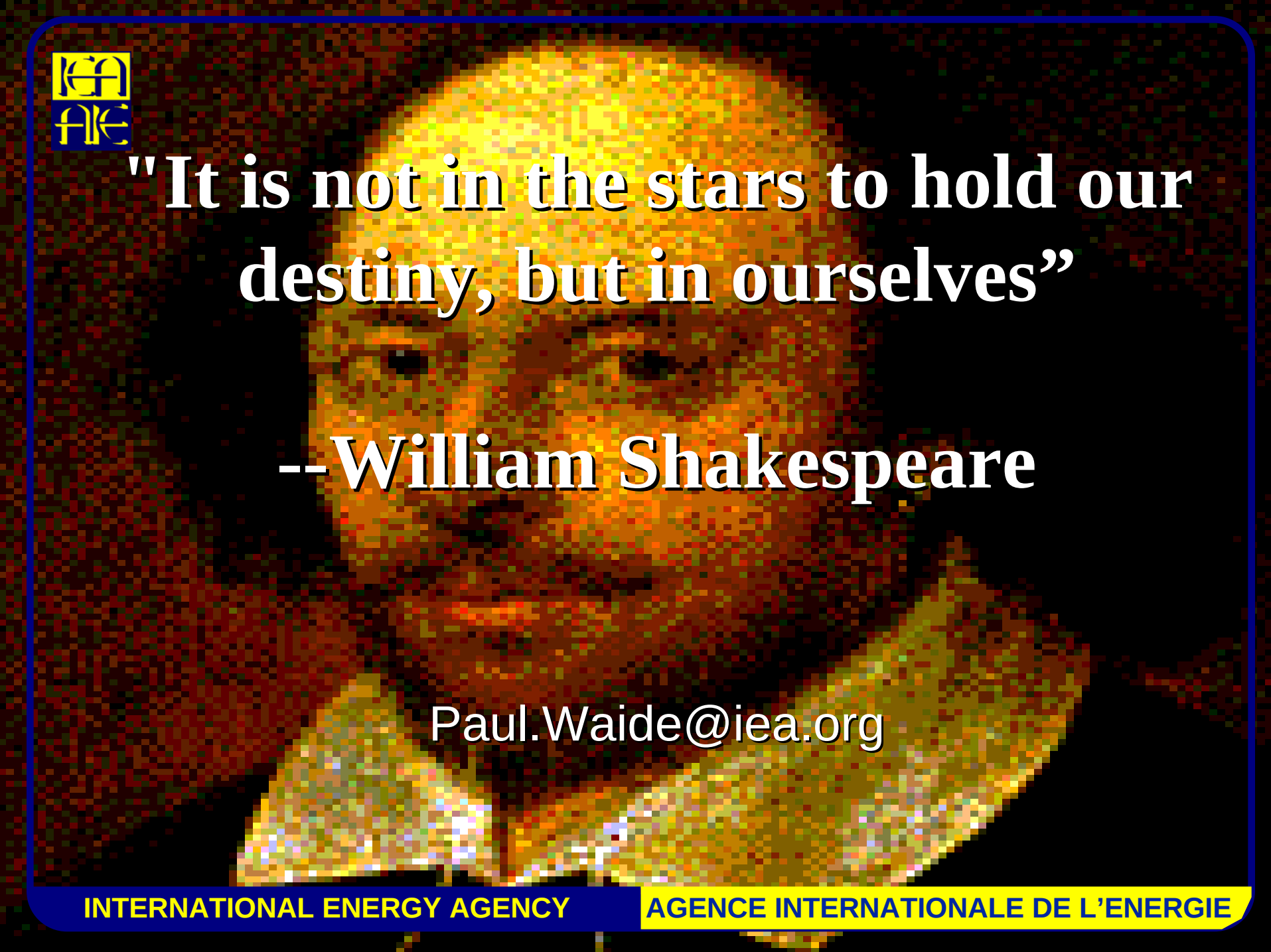
- Globally incandescent lamps are estimated to have accounted for 970 TWh of final electricity consumption and 560 Mt of CO_2 in 2005
- About 61% of this demand was in the residential sector with most of the rest in commercial and public buildings
- With current trends incandescent lamps could use 1610 TWh of final electricity by 2030
- In the hypothetical case that all these lamps were to be replaced by CFLs it would save roughly 800 TWh and 470 Mt CO_2 emissions in 2010 rising to 1200 TWh and 700 Mt CO_2 in 2030

Barriers to efficient lighting

- Lack of user awareness
- Lack of information
- Customers don't look at total ownership cost – just initial price
- Split incentives
- Low priority
- Some product labelling/quality issues

Some policies to bring it about

- Minimum energy performance standards and labelling for lamps, ballasts & luminaires
- Police CFL quality and provide incentives to adopt good CFLs in place of incandescent lamps
- Building codes setting performance requirements for lighting
- Fiscal incentives
- Increase public awareness and market transformation efforts
- But what is the right blend?


"It is not in the stars to hold our destiny, but in ourselves”
--William Shakespeare
Paul.Waide@iea.org
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