

Accounting for externalities

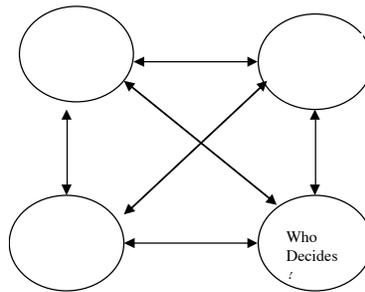
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For any regulatory issue, four types of questions must be resolved:



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Success Criteria for Regulatory Intervention

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Success criteria for regulatory intervention

- Improvement
- Equity
- Efficiency

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Definition of external costs

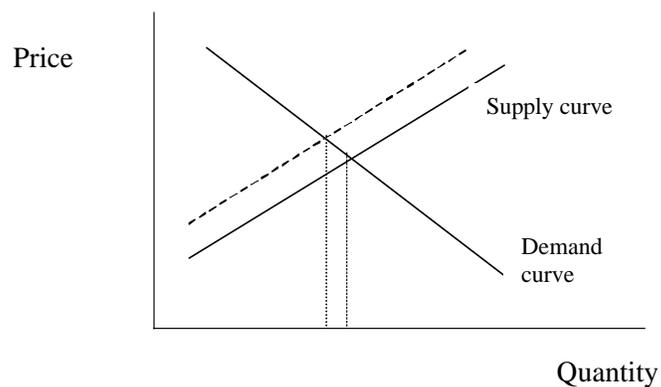
“ Fuel cycle externalities are the costs imposed on society and the environment that are not accounted for by the producers and consumers of energy, i.e. that are not included in the market price. They include damage to the natural and built environment, such as effects of air pollution on health, buildings, crops, forests and global warming; occupational disease and accidents; and reduced amenity from visual intrusion of plant or emissions of noise. Traditional economic assessment of fuel cycles has tended to ignore these effects.”
-- European Commission

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Failure to take account of external costs will result in excessive pollution



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- The effect of regulation is to internalize
 - Mandatory controls on technology
 - Mandatory emissions limits
- But regulations do not eliminate external costs
- In principle, want to minimize total social cost (= internal cost + residual external cost)
- In practice, external costs haven't been considered until recently
- Now there are attempts to do so
 - Resource/technology selection decisions
 - Emissions taxes
 - Subsidies of renewables on the basis of avoided external costs

Representative Externality Assessment Inputs

Units are Dollars Per Metric Ton

<u>Emissions</u>	State			
	NY PSC	MA DPU	NV PSC	CA PU
SO ₂	900	1650	1720	4500
NO _x	1960	7170	7500	7800
VOCs	-	5840	1300	3600
CO	-	950	1000	-
Particulates	350	4400	4600	2600
CO ₂	2.2	24	24	29
CH ₄	-	240	240	-
N ₂ O	-	4400	4600	-

Source: Economic Research Associates (1992), cited in R. W. Larson et al (eds), *Economics of Solar Energy Technologies*, America Solar Energy Society, Dec. 1992

Table 1 Damages of air pollutants (in ECU per t of pollutant emitted)

Country	SO ₂	NO _x	Particulates
Austria	9,000	9,000-16,800	16,800
Belgium	11,388-12,141	11,536-12,296	24,536-24,537
Denmark	2,990-4,216	3,280-4,728	3,390-6,666
Finland	1,027-1,486	852-1,388	1,340-2,611
France	7,500-15,300	10,800-18,000	6,100-57,000
Germany	1,800-13,688	10,945-15,100	19,500-23,415
Greece	1,978-7,832	1,240-7,798	2,014-8,278
Ireland	2,800-5,300	2,750-3,000	2,800-5,415
Italy	5,700-12,000	4,600-13,567	5,700-20,700
The Netherlands	6,205-7,581	5,480-6,085	15,006-16,830
Norway	na	na	na
Portugal	4,960-5,424	5,975-6,562	5,565-6,955
Spain	4,219-9,583	4,651-12,056	4,418-20,250
Sweden	2,357-2,810	1,957-2,340	2,732-3,840
United Kingdom	6,027-10,025	5,736-9,612	8,000-22,917

Source: European Commission, ExternE Project, <http://externe.jrc.es/All-EU+Summary.htm>

Note: The differences in part reflect differences in the size of the affected populations in the different countries.

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Figures

External costs (for electricity production in the EU (in cent/kWh**, PV = photovoltaics)

Country	Coal & lignite	Peat	Oil	Gas	Nuclear	Biomass	Hydro	PV	Wind
AUT				1-3		2-3	0.1		
BE	4-15			1-2	0.5				
DE	3-6		5-8	1-2	0.2	3		0.6	0.05
DK	4-7			2-3		1			0.1
ES	5-8			1-2		3-5*			0.2
FI	2-4	2-5				1			
FR	7-10		8-11	2-4	0.3	1	1		
GR	5-8		3-5	1		0-0.8	1		0.25
IE	6-8	3-4							
IT			3-6	2-3			0.3		
NL	3-4			1-2	0.7	0.5			
NO				1-2		0.2	0.2		0-0.25
PT	4-7			1-2		1-2	0.03		
SE	2-4					0.3	0-0.7		
UK	4-7		3-5	1-2	0.25	1			0.15

* : biomass co-fired with lignites
 ** : sub-total of quantifiable externalities
 (such as global warming, public health, occupational health, material damage)

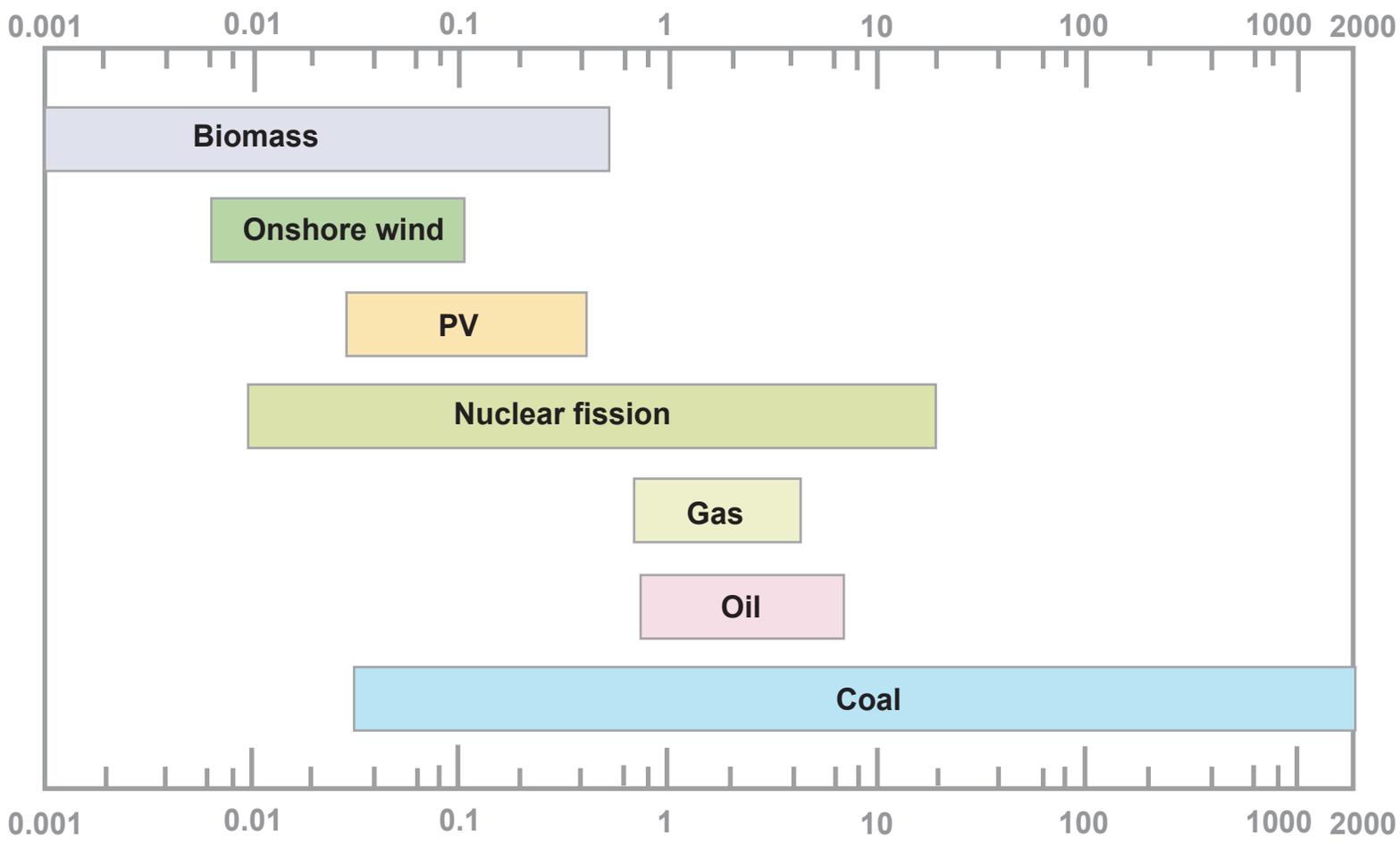
Source: European Commission, ExternE project

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**Decimal log scale
¢/kWh (1988)**



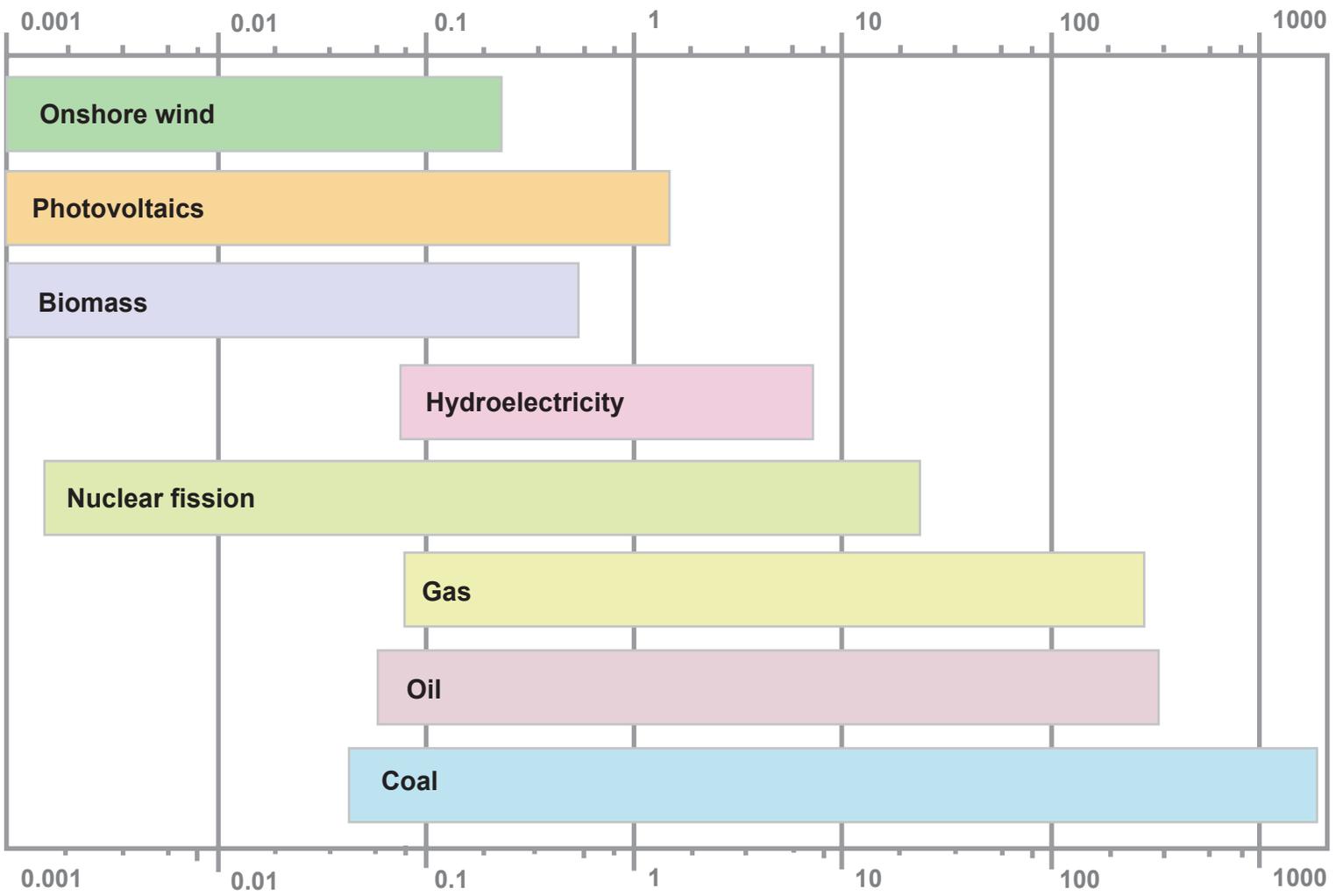
Environmentally Related Damage Costs for Selected Electricity Supply Technologies (excluding global warming)

Source: A. Sterling, "Regulating the Electricity Supply Industry by Valuing Environmental Effects," *Futures*, Dec. 1992, pp. 1024-47; as presented in D. Toke in Ref. T-1.

stated external environmental cost (bars represent range over a variety of studies)

1995 c/kWh

logarithmic scale



Range of Externality Study Estimates (including global warming)
from Ref. S-3

Source: A. Sterling, *Futures*, Dec. 1992, pp. 1024-47