Hierarchy level	Criteria name (short name)	Description	Best value = min. or max.	Unit
1	ENVIRONMENT	Environment related criteria Source: NEEDS Research Streams 1a & 2b, using Life Cycle Analysis (LCA)		
1.1	RESOURCES	Resource use (non-renewable)		
1.1.1	Energy	Energy resource use in whole life-cycle		
1.1.1.1	Fossil fuels	This criterion measures the total primary energy in the fossil resources used for the production of 1 kWh of electricity. It includes the total coal, natural gas and crude oil used for each complete technology chain. Note: Using coal fired technologies as an example; the total primary energy also includes the energy from oil used in transportation as well as from natural gas in the electricity mix used for mining and processing.	min	MJ/kWh
1.1.1.2	Uranium	This criterion quantifies the primary energy from uranium resources used to produce 1 kWh of electricity. It includes the total use of uranium for each complete electricity generation technology chain.	min	MJ/kWh
1.1.2	Minerals	Mineral resource use in whole life-cycle		
1.1.2.1	Metal ore	This criterion quantifies the use of selected scarce metals used to produce 1 kWh of electricity. It is based on the Life Cycle Impact Assessment method "CML 2001". The use of all single metals is expressed in antimony-equivalents, based on the scarcity of their ores relative to the reference ore (antimony).	min	kg(Sb-eq.)/kWh
1.2	CLIMATE	Potential impacts on the climate		
1.2.1.1	Carbon dioxide emissions (CO_2 emissions)	This criterion includes the total for all different greenhouse gases expressed in kg of CO_2 equivalent for each electricity generation technology. It addresses the potential negative impacts of global climate change caused by the greenhouse gases from the production of 1 kWh of electricity.	min	kg(CO_2-eq.)/kWh
1.3	ECOSYSTEMS	Potential impacts to ecosystems		
1.3.1	Normal operation (Normal op.)	Ecosystem impacts from normal operation		
1.3.1.1	Biodiversity	This criterion quantifies the loss of species (flora & fauna) due to the land used to produce 1 kWh of electricity. The "potentially damaged fraction" (PDF) of species is multiplied by land area and years for each complete electricity generation technology chain.	min	PDF*m^2*a/kWh
1.3.1.2	Ecotoxicity	This criterion quantifies the loss of species (flora & fauna) due to ecotoxic substances released to air, water and soil to produce 1 kWh of electricity. The "potentially damaged fraction" (PDF) of species is multiplied by land area and years for each complete electricity generation technology chain.	min	PDF*m^2*a/kWh

Hierarchy level	Criteria name (short name)	Description	Best value = min. or max.	Unit
1.3.1.3	Air pollution	This criterion quantifies the loss of species (flora & fauna) due to acidification and eutrophication caused by pollution from production of 1 kWh of electricity. The "potentially damaged fraction" (PDF) of species is multiplied by land area and years for each complete electricity generation technology chain.	min	PDF*m²*a/kWh
1.3.2	Severe accidents (Severe acc.)	Ecosystem impacts in the event of severe accidents		
1.3.2.1	Hydrocarbons	This criterion quantifies large accidental spills of hydrocarbons to the environment, which can potentially damage affected ecosystems. It considers severe accidents only, i.e. releases of at least 10000 tonnes.	min	t/GWeyr
1.3.2.2	Land contamination (Land contam.)	This criterion quantifies land contaminated due to accidents releasing radioactive isotopes. The land area contaminated is estimated using Probabilistic Safety Analysis (PSA). Note that this indicator is restricted to the nuclear electricity generation technology chain.	min	km²/GWeyr
1.4	WASTE	Potential impacts due to waste		
1.4.1.1	Chemical waste	This criterion quantifies the total mass of special chemical wastes stored in underground repositories due to the production of 1 kWh of electricity. It does not reflect actual damage to humans or nature and does not reflect the confinement time required for each repository.	min	kg/kWh
1.4.1.2	Radioactive waste (Rad. waste)	This criterion quantifies the volume of low, medium and high level radioactive wastes stored in underground repositories due to the production of 1 kWh of electricity. It covers each complete electricity generation technology chain and does not reflect actual damage to humans or nature. It also does not reflect the confinement time required for the repository.	min	m³/kWh
2	ECONOMY	Economy related criteria Source: NEEDS Research Stream 2b contributors for different technologies.		
2.1	CUSTOMERS	Economic effects on customers		
2.1.1.1	Generation cost (Gen. Cost)	This criterion gives the average generation cost per kilowatt-hour (kWh) for each technology, including the capital cost of the plant, (fuel), and operation and maintenance costs. It is the cost to the utility of generating electricity and not the end price that the customer must pay.	min	EUR/MWh
2.2	SOCIETY	Economic effects on society		

Hierarchy level	Criteria name (short name)	Description	Best value = min. or max.	Unit
2.2.1.1	Direct jobs	This criterion gives the amount of employment directly related to building and operating the generating technology, including the direct labour involved in extracting or harvesting and transporting fuels (when applicable). Indirect labour (e.g fabricating plant components) is not included. The employment is measured in terms of man-years of labour and averaged over the generation, i.e. units are person-years/GWh.	max	Person-years/GWh
2.2.1.2	Fuel autonomy	Utility companies and the societies they serve may be vulnerable to interruptions in service if imported fuels are unavailable due to economic or political problems related to energy resource availability. This measure of vulnerability is based on expert judgment (of related factors), including whether a resource is domestic or imported, renewable or finite, and the relative size of different finite resources.	max	Ordinal
2.3	UTILITY	Economic effects on utility company		
2.3.1	Financial	Financial impacts on utility		
2.3.1.1	Financing risk	Utility companies can face a considerable financial risk if the total cost of a new electricity generating plant is very large compared to the overall size of the company. These risks can require forming necessary partnerships with other utilities or raising capital through financial markets.	min	Million EUR, NPV (NPV = Net Present Value)
2.3.1.2	Fuel sensitivity	The fraction of fuel cost to overall generation cost can range from zero (solar PV) to low (nuclear power) to high (gas turbines). This fraction therefore indicates how sensitive the generation costs would be to a change in fuel prices.	min	Factor
2.3.1.3	Construction time (Constr. Time)	Once a utility has started building a plant it is vulnerable to public opposition, resulting in delays and other problems, driving up the total cost. This indicator therefore gives the expected plant construction time in years. Time required for planning and regulatory approval is not included, as the bulk of spending occurs after the start of construction.	min	Years
2.3.2	Operation	Factors related to a utility company's operation of a technology.		
2.3.2.1	Marginal cost	Generating companies “dispatch” or order their plants into operation according to their variable cost, starting with the lowest cost baseload plants up to the highest cost plants at peak load periods. This variable (or dispatch) cost is the cost to run the plant, without the cost to build it. It is equal to the average fuel cost plus variable operation and maintenance costs per kilowatt-hour.	min	EUR-cents/kWh
2.3.2.2	Flexibility	In order to plan the operation of their generating plants at least a day in advance, utilities need forecasts of generation they cannot control (renewable resources like wind and solar), and the necessary start-up and shut-down times required for the plants they can control. This indicator combines these two measures of planning flexibility, based on expert judgment, including the logarithmic nature of planning time (the difference between 1 and 2 hours advance notice is more important in planning than the difference between 11 and 12 hours).	max	Ordinal

Hierarchy level	Criteria name (short name)	Description	Best value = min. or max.	Unit
2.3.2.3	Availability	All technologies can have plant outages or partial outages (less than full generation), due to either equipment failures (forced outages) or due to maintenance (unforced or planned outages). This indicator tells the fraction of the time that the generating plant is available to generate power. Partial outages are accounted for by making an annual average equivalent availability factor, equal to the expected possible annual generation divided by maximum annual generation at full power.	max	Factor
3	SOCIAL	Socially related criteria Source: NEEDS Research Stream 2b survey of social experts for most indicators (indicated by ordinal scale for units). Quantitative risk measures based on PSI risk database.		
3.1	SECURITY	Social Security		
3.1.1	Political continuity (Pol. Continuity)	Political continuity		
3.1.1.1	Secure supply	This criterion refers to the market concentration of energy suppliers in each primary energy sector that could lead to economic or political disruption. It is based on expert judgement.	min	Ordinal scale
3.1.1.2	Waste repository (Waste repos.)	The criterion is based on the possibility that an infrastructure of storage facilities will not be available in time to take deliveries of waste materials from the fuel chain, including from the fuel supply, plant construction, operation and decommissioning of the plant.	min	Ordinal scale
3.1.1.3	Adaptability	The criterion refers to the technical characteristics of each electricity generation technology that may make it flexible in implementing technical progress and innovations.	max	Ordinal scale
3.2	POLITICAL LEGITIMACY (Political Legit.)	Political legitimacy		
3.2.1.1	Conflict	The indicator refers to conflicts that are based on historical evidence. It is related to the characteristics of energy systems that trigger conflicts.	min	Ordinal scale
3.2.1.2	Participation	This criterion is based on the fact that certain types of technologies require public, participative decision-making processes, especially for construction or operating permits or licenses.	min	Ordinal scale
3.3	RISK	Risk		
3.3.1	Normal risk	Normal operation risk Source: NEEDS Research Stream 2b for life cycle risk data		

Hierarchy level	Criteria name (short name)	Description	Best value = min. or max.	Unit
3.3.1.1	Mortality	This criterion is based on the increased rate of mortality due to normal operation of the electricity generation technology and its associated energy chain. It is measured in the years of life lost (YOLL) by the entire population, compared to the expected lifetimes without the technology in question.	min	YOLL/kWh
3.3.1.2	Morbidity	This criterion is based on the increased rate of sickness or morbidity due to normal operation of the electricity generation technology and its associated energy chain. It is measured in the years of life affected by disabilities (disability adjusted life years, or DALY) suffered by the entire population, compared to their expected health without the technology in question.	min	DALY/kWh
3.3.2	Severe accidents (Sev. Accidents)	Risk from severe Accidents Source: NEEDS Research Stream 2b for severe accident data		
3.3.2.1	Accident mortality (Acc. Mortality)	This criterion is based on the number of fatalities expected for each kWh of electricity that occur in severe accidents with 5 or more deaths per accident for a particular electricity generation technology chain.	min	Fatalities/GWeyr
3.3.2.2	Maximum fatalities (Max. fatalities)	This criterion is based on the maximum number of fatalities that are reasonably credible for a single accident for a particular electricity generation technology chain.	min	Fatalities/accident
3.3.3	Perceived risk	Perceived risk		
3.3.3.1	Normal operation	This criterion is based on citizens' fear of negative health effects due to normal operation of the electricity generation technology.	min	Ordinal scale
3.3.3.2	Perceived accidents (Perceived acc.)	This criterion is based on citizens' perception of risk characteristics, including whether they can control the risk personally, whether the potential damage is small or catastrophic, and their familiarity with the risk.	min	Ordinal scale
3.3.4	Terrorism	Risk of terrorism		
3.3.4.1	Terror-Potential	This criterion indicates the potential for a successful terrorist attack on a specific technology, based on its vulnerability, the potential damage and public perception of risk.	min	Ordinal scale
3.3.4.2	Terror-Effects	This criterion concerns the potential likely consequences of a successful terrorist attack. The criterion implicitly addresses the aversion towards low-probability high-consequence accidents.	min	Expected number of fatalities
3.3.4.3	Proliferation	This criterion represents the potential for misuse of technologies or substances present in the nuclear electricity generation technology chain, based on both their presence and the risk of such misuse or diversion.	min	Ordinal scale

Hierarchy level	Criteria name (short name)	Description	Best value = min. or max.	Unit
3.4	RESIDENTIAL ENVIRONMENT (Residential env.)	Quality of the residential environment		
3.4.1.1	Landscape	This criterion is based on the overall functional and aesthetic impact on the landscape of the entire infrastructure related to each electricity generation technology chain, including mines, transmission lines or pipelines, structures, etc. Note: Excludes traffic.	min	Ordinal scale
3.4.1.2	Noise	This criterion is based on the amount of noise caused by the generation plant, as well as transport of materials to and from the plant (e.g. trucking of fuel and/or waste).	min	Ordinal scale