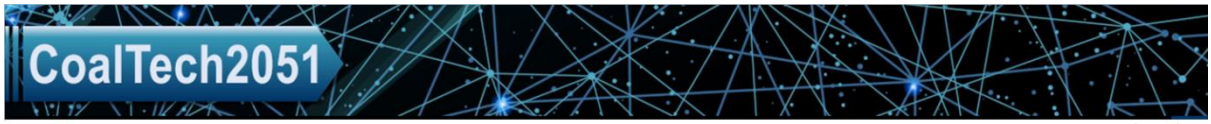
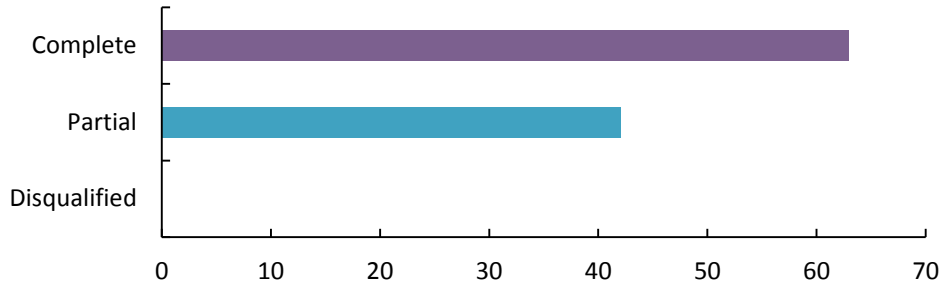


Statistical report for CoalTech2051 - Delphi survey (Round I)

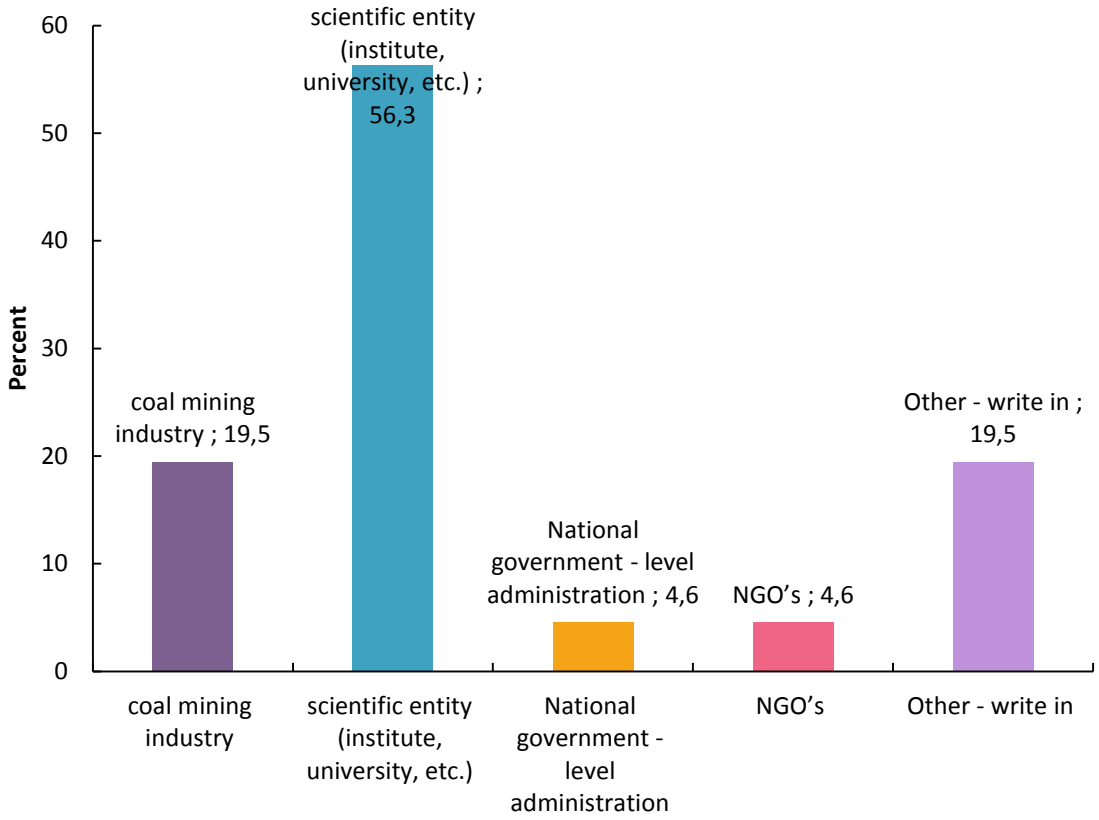
CoalTech2051 - Delphi survey (Round I)

Response Statistics



	Count	Percent
Complete	63	60
Partial	42	40
Disqualified	0	0
Totals	105	

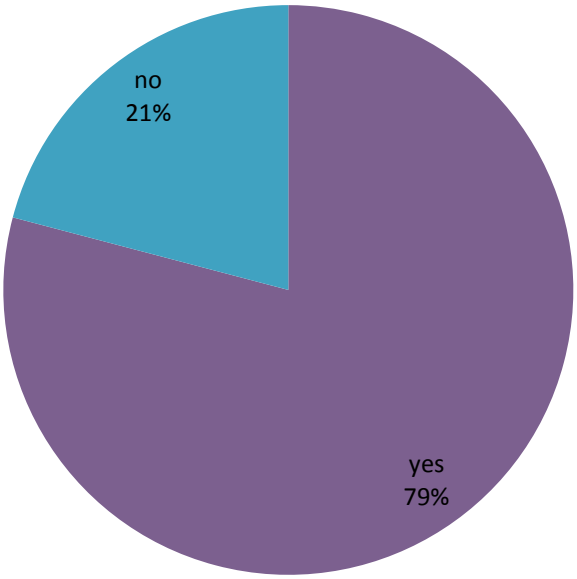
1.Which type of institution or sector do work in:



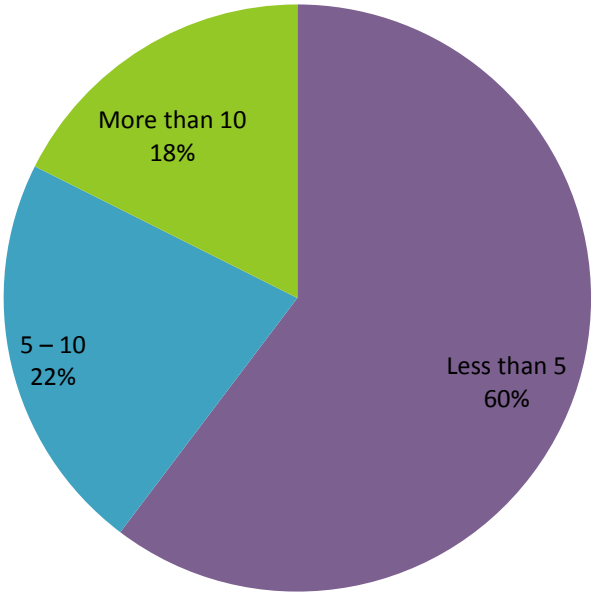
Value	Percent *	Count
coal mining industry	19.5%	17
scientific entity (institute, university, etc.)	56.3%	49
National government - level administration	4.6%	4
NGO's	4.6%	4
Other	19.5%	17

*expert may identify more than one institution

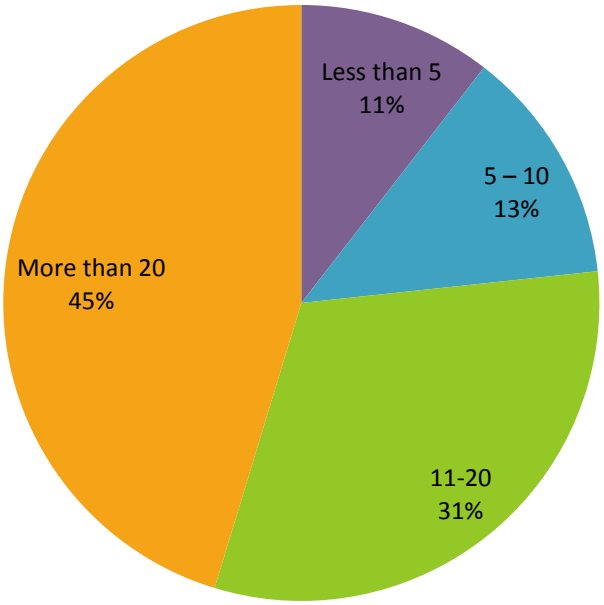
2.Did you participate in the implementation of research projects related to coal?



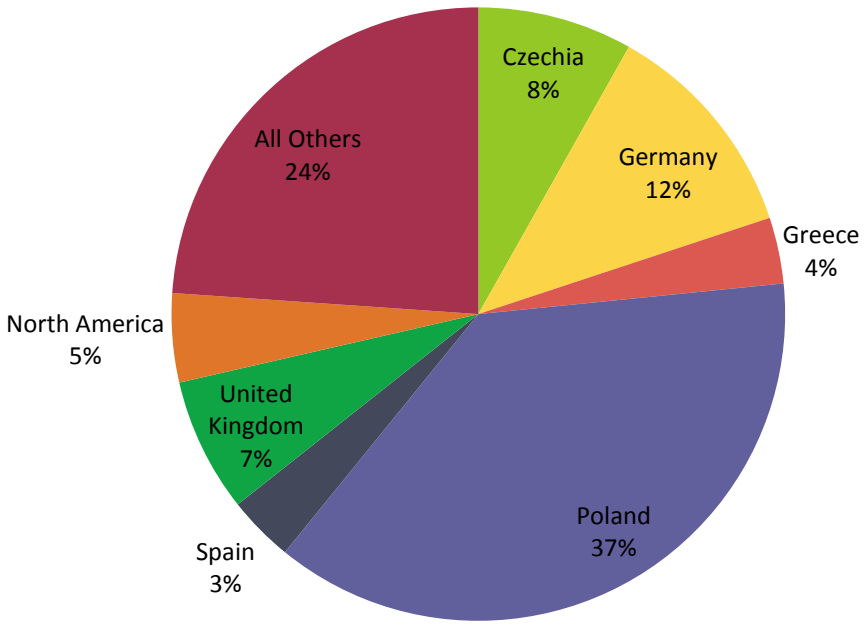
3.How many projects?



4.How many years of experience you have?



5.Which country or world region are you based in?



6.SOCIAL Coal R&D:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Responses
	Row %					Count
Improves health and safety.	2.9%	2.9%	7.2%	55.1%	31.9%	69
Creates new employment outside of R&D.	1.4%	7.2%	17.4%	50.7%	23.2%	69
Improves land planning and control and approvals processes.	3.0%	7.5%	28.4%	49.3%	11.9%	67

Experts propositions:

- Continues the cycle of climate, social & environmental destruction
- Contributes to revitalize regions through the development of clusters, skills on innovation etc.
- Creates opportunities for upgrading coal R&D
- Ensures equal technological advancement worldwide
- Explain how coal is important for our life
- Helps keeping competitive position of coal energy
- Improve acceptance of coal as clean energy resources
- Improves indoor and outdoor air quality
- Increases social acceptance of related projects
- Inform public opinion on new clean coal processes
- Is an utter waste of money and time that would be better spent helping communities justly transition away from coal
- Improes accptance of coal as natural resources and raw material
- Indigeneous raw material resource
- New material like coal fibre replacing steel

7.TECHNOLOGICAL Coal R&D:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Responses
	Row %					Count
Develops advanced clean coal technologies.	1.4%	1.4%	8.7%	37.7%	50.7%	69

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Responses
	Row %					Count
Exploits new information and communications technology (ICT).	%	7.2%	23.2%	49.3%	20.3%	69
Leads to new applications for coal.	3.0%	3.0%	9.0%	52.2%	32.8%	67

Experts propositions:

- Creates ongoing utility for a resource that has to stay in the ground if we are to keep the planet habitable
- Decrease in coal consumption
- Enables to overcome challenges that come with fight with climate changes
- Helps to identify innovative technologies related to the circular economy
- Impacts combustion technologies
- Improve and sustain knowledge for R&D
- Integrates digitalization into the related technological applications
- Is a waste of time and money that would be better spent on clean energy technologies
- Develop new carbon materials based on coal
- Provides new paths for various resource-related industries (chemical/material/production/processing etc.)
- Improves catalytic glowing instead of flame burning
- Improves and sustain education of the sector
- Use CO_2 as raw material

8.ENVIRONMENTAL Coal R&D:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Responses
	Row %					Count
Supports climate action.	4.4%	5.9%	16.2%	42.6%	30.9%	68
Reduces emissions to land, air and water.	1.5%	2.9%	5.9%	51.5%	38.2%	68
Quantifies environmental impact of particular technologies	%	1.5%	8.8%	54.4%	35.3%	68

Experts propositions:

- Broad (erroneous) belief that accidental emissions are inherent in the fuel
- Develops new tools for the optimal environmental reclamation planning of the related projects:
- Gives us information that is ultimately useless as we know coal use has to end in the next 10 years
- Helps mitigating future energy problems
- Identifies coal substitution opportunities
- Improved domestic technologies are being overlooked
- Provides solutions for the environmental protection and successful gradual closure of related activities
- Reduces anthropogenic fingerprint with reuse and processing wastes
- Reduces the use of natural resources
- Delays decarbonization

9.POLITICAL Coal R&D:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Responses
	Row %					Count
Reduces energy-import dependency.	2.9%	11.6%	20.3%	27.5%	37.7%	69
Provides technical support to strategic policy objectives, laws and regulations.	%	4.3%	14.5%	49.3%	31.9%	69
Improves environmental monitoring guidelines.	1.4%	1.4%	15.9%	46.4%	34.8%	69

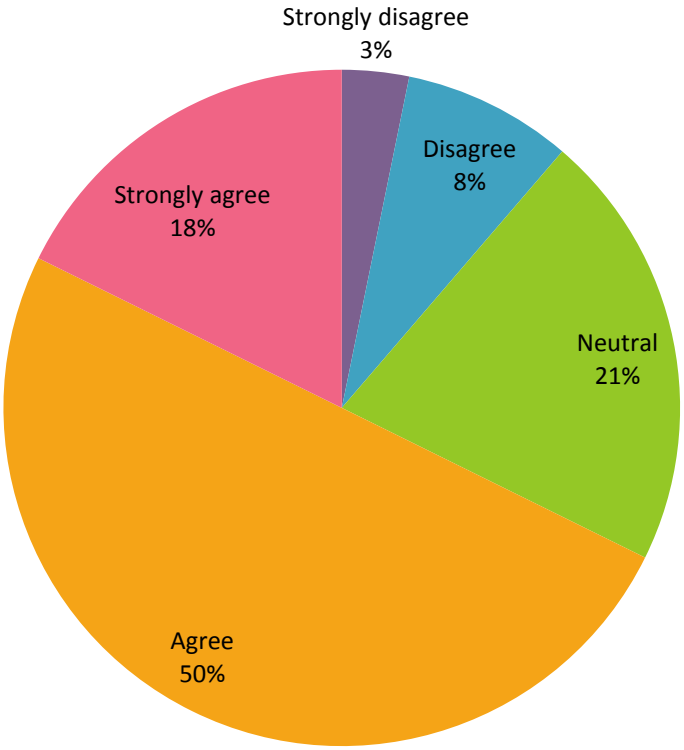
Experts propositions:

- Coal gasification provides low cost alternative to imported natural gas
- Creates yet more time wasting roadblocks to solving the climate crisis
- Helps to develop strategic policy objectives
- Improves the economic diversification and technological transition
- Provides a distraction for politicians looking to halt climate action
- Creates the illusion of "clean coal”
- Develop coal industry where none existed before
- Improves resource economy countrywide and worldwide

10.Additional observations and comments

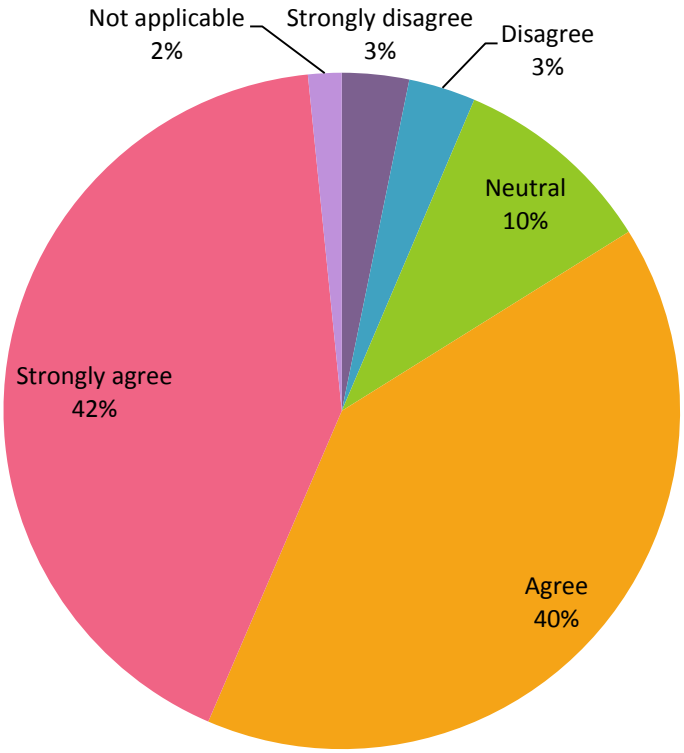
Results in the form of a cloud of topics:

11. T.1.1. Ensuring the exploitation of coal reserves based on methods and tools for identifying the size and availability of resources.



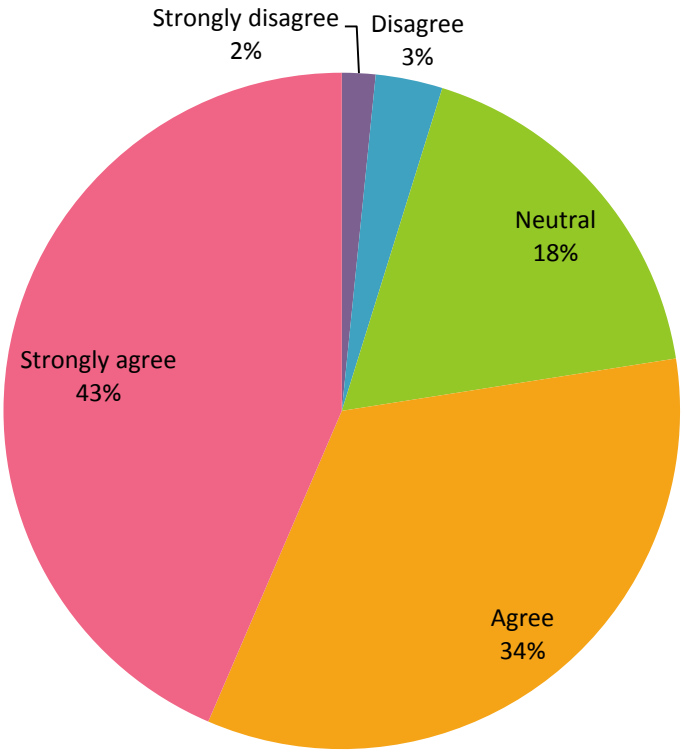
Value	Percent	Count
Strongly disagree	3.2%	2
Disagree	8.1%	5
Neutral	21.0%	13
Agree	50.0%	31
Strongly agree	17.7%	11
	Totals	62

12.T.1.2. Development of breakthrough technologies for alternative (unconventional) methods of resource exploitation



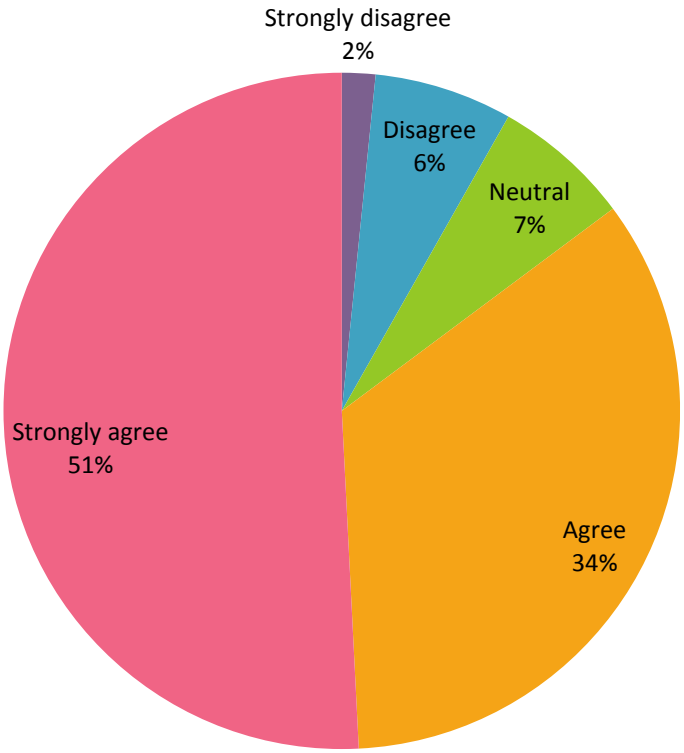
Value	Percent	Count
Strongly disagree	3.2%	2
Disagree	3.2%	2
Neutral	9.7%	6
Agree	40.3%	25
Strongly agree	41.9%	26
Not applicable	1.6%	1
	Totals	62

13.T.1.3. Improvement of coal production and processing technologies improving the efficiency and productivity of mining processes



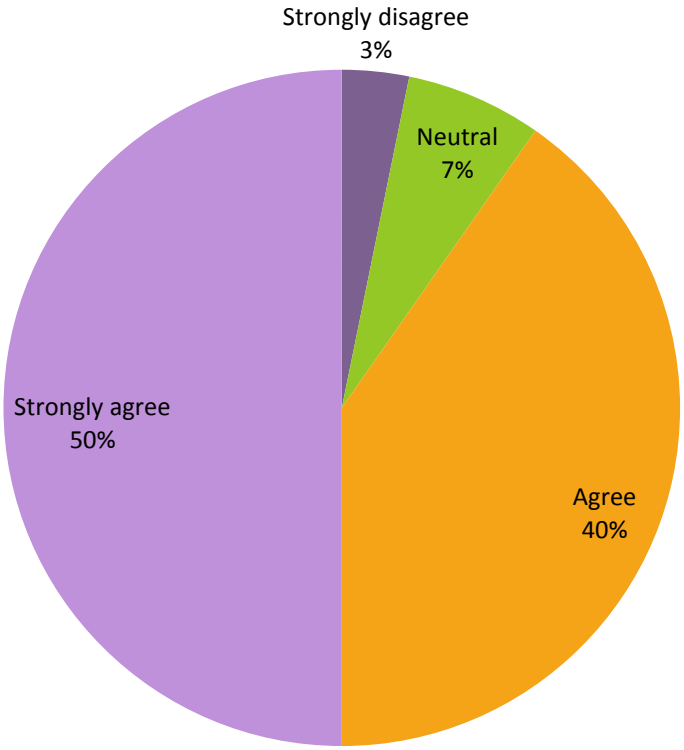
Value	Percent	Count
Strongly disagree	1.6%	1
Disagree	3.2%	2
Neutral	17.7%	11
Agree	33.9%	21
Strongly agree	43.5%	27
	Totals	62

14.T.1.4. Satisfying the energy needs of the global economy still depends on coal, which requires the development of more efficient and low-carbon technologies.



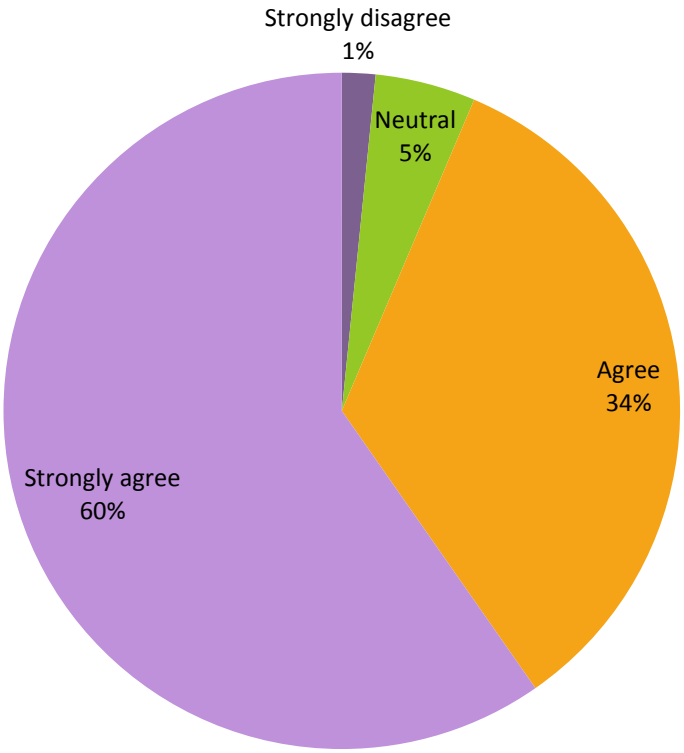
Value	Percent	Count
Strongly disagree	1.6%	1
Disagree	6.6%	4
Neutral	6.6%	4
Agree	34.4%	21
Strongly agree	50.8%	31
	Totals	61

15.T.1.5. Further exploitation of coal deposits requires, first of all, safe and healthy working conditions.



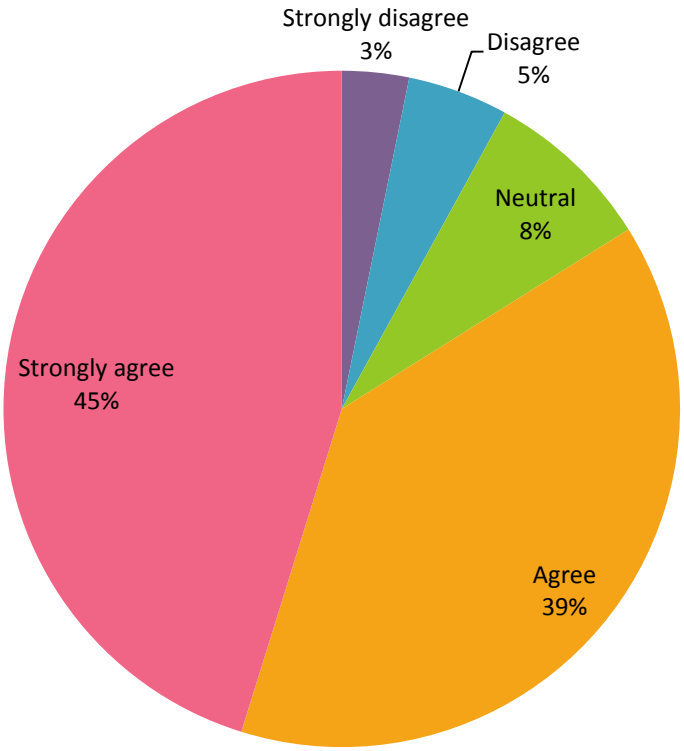
Value	Percent	Count
Strongly disagree	3.2%	2
Neutral	6.5%	4
Agree	40.3%	25
Strongly agree	50.0%	31
	Totals	62

16.T.1.6. At all stages in the coal value chain, environmental issues have to be addressed.



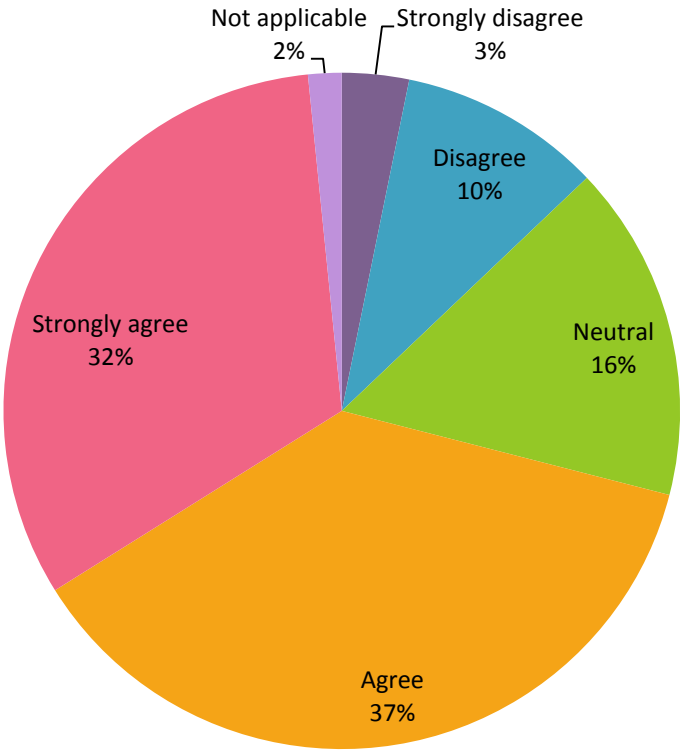
Value	Percent	Count
Strongly disagree	1.6%	1
Neutral	4.8%	3
Agree	33.9%	21
Strongly agree	59.7%	37
	Totals	62

17.T.2.1. The energy transition may drive the development of a new generation of coal conversion technologies to provide a greater variety of products from coal with new applications.



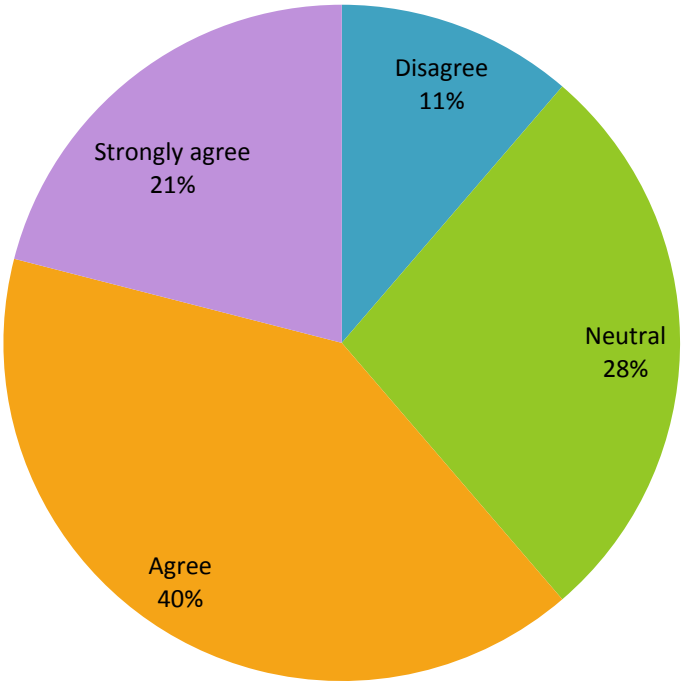
Value	Percent	Count
Strongly disagree	3.2%	2
Disagree	4.8%	3
Neutral	8.1%	5
Agree	38.7%	24
Strongly agree	45.2%	28
	Totals	62

18.T.2.2. A fall in demand for coal as an energy source affects the development of research on alternative uses.



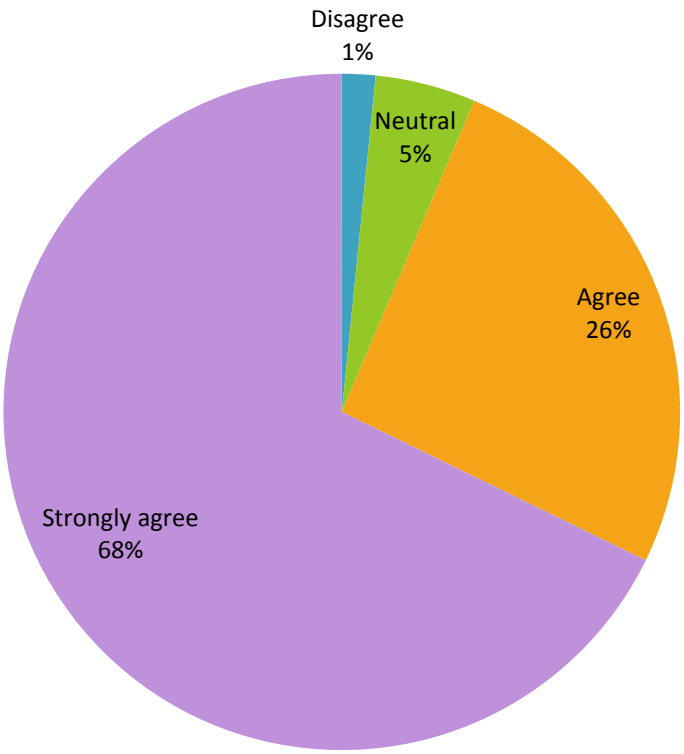
Value	Percent	Count
Strongly disagree	3.2%	2
Disagree	9.7%	6
Neutral	16.1%	10
Agree	37.1%	23
Strongly agree	32.3%	20
Not applicable	1.6%	1
	Totals	62

19.T.2.3. Resource-intensive and energy-intensive processes may be replaced by closed-cycle or circular technologies.



Value	Percent	Count
Disagree	11.3%	7
Neutral	27.4%	17
Agree	40.3%	25
Strongly agree	21.0%	13
	Totals	62

20.T.2.4. In regions where mining activity is being terminated, it is necessary to develop and implement solutions enabling the management and use of post-mining areas in order to preserve their value.



Value	Percent	Count
Disagree	1.6%	1
Neutral	4.8%	3
Agree	25.8%	16
Strongly agree	67.7%	42
	Totals	62

21.Additional observations and comments

Results in the form of a cloud of topics:

22.Coal exploration - The exploitation of coal resources depends on having good knowledge of deposits at all stages, from prospecting through to post-mining. The development of new methods and tools can increase the base of economic reserves.

	2020	2025	2030	2035	2040+	never	Responses
	Row %						Count
Deep penetration geophysical techniques with improved resolutions to depths of 1000 m or more	15.5%	25.9%	22.4%	12.1%	13.8%	10.3%	58
Resource data analysis tools with improved data visualization and integration with resource management tools	17.5%	47.4%	15.8%	12.3%	1.8%	5.3%	57
Conceptual modelling of coal deposits	20.7%	36.2%	19.0%	8.6%	10.3%	5.2%	58

Experts propositions:

- Advanced tools for forecasting run-off coal quality
- Availability of coal deposits by their depth, LHV or "challenges" (e.g. sulphur and Hg content)
- Hydrogeology at depths of 1000m plus
- Reliable geotechnical and hydrogeological modeling of the deposits
- Waste characterization for effective post mining activities

23.Coal extraction - The economics of coal production can improve dramatically with technological transformations in the mining sector. Incremental improvements also offer a way to accelerate productivity improvements.

	2020	2025	2030	2035	2040+	never	Responses
	Row %						Count
Coal extraction methods to increase resource recovery and reduce waste	12.1%	34.5%	20.7%	13.8%	10.3%	8.6%	58
Automation, remote control and robotisation of mining equipment	10.2%	25.4%	35.6%	10.2%	16.9%	1.7%	59
Handling and processing technologies to improve efficiency and quality	15.5%	39.7%	27.6%	5.2%	10.3%	1.7%	58

Experts propositions:

- Advanced mine planning and scheduling in relation to energy efficiency of mining operation
- Advanced tools for optimizing mining equipment operation in relation to specific mining conditions
- Development of tools for monitoring and minimizing environmental impacts of mining operations:
- Fully automated extraction up to delivery to port

24.Unconventional coal exploitation - Alternative ways to exploit coal resources, such as coalbed methane, may depend on technological breakthroughs.

	2020	2025	2030	2035	2040+	never	Responses
	Row %						Count
Deep drilling technologies (>1000 m)	13.8%	29.3%	24.1%	12.1%	12.1%	8.6%	58
Modelling exploitation over time	14.0%	31.6%	19.3%	19.3%	14.0%	1.8%	57
Innovative exploitation techniques	10.5%	17.5%	24.6%	21.1%	24.6%	1.8%	57

Experts propositions:

- Broader application of cost-effective exploitation techniques
- Environmental modeling and risk analysis methods
- Modeling and investigating the effect of unconventional coal exploitation on the stability of surrounding rocks
- Monitoring exploitation and environment on time

25.Coal conversion and processing - The energy transition may drive the development of a new generation of coal conversion technologies to provide a greater variety of products from coal with new applications.

	2020	2025	2030	2035	2040+	never	Responses
	Row %						Count
Crushing, separation and processing of coal seams, including ultrafines	22.8%	31.6%	24.6%	12.3%	3.5%	5.3%	57
Hydrogen production from coal	15.8%	17.5%	26.3%	15.8%	19.3%	5.3%	57
Fuels and chemical synthesis from coal	11.9%	32.2%	20.3%	18.6%	15.3%	1.7%	59

Experts propositions:

- CCS
- Recycling and secondary fuel /chemical production from CO_2

26.Coal utilisation - Conventional coal-fired power generation continues to evolve and there appears to be a clear route forward towards higher efficiency and lower emissions.

	2020	2025	2030	2035	2040+	never	Responses
	Row %	Row %	Row %	Row %	Row %	Row %	Count
High-efficiency, low-emission technologies at flexible conventional thermal power plants	18.3%	33.3%	18.3%	6.7%	16.7%	6.7%	60
Coal gasification and co-gasification with wastes (e.g. RDF/SRF, electronic, plastic) and biomass	16.7%	36.7%	18.3%	11.7%	10.0%	6.7%	60
Direct carbon fuel cells	3.4%	22.4%	29.3%	19.0%	20.7%	5.2%	58

27.Non-energy uses of coal - As coal use for its energy value declines in Europe, non-energy applications could become an important part of the market for coal.

	2020	2025	2030	2035	2040+	never	Responses
	Row %						Count
Carbon-based materials (e.g. carbon fibres and nanostructures)	13.8%	29.3%	29.3%	10.3%	15.5%	1.7%	58
Chemicals	15.3%	37.3%	23.7%	5.1%	18.6%	%	59
Fertilisers	17.2%	27.6%	25.9%	10.3%	19.0%	%	58

Experts propositions:

- Critical & Rare Earth Element extraction from coal ash
- Geopolymers from coal ash

28.Carbon recycling and materials recovery - Resource-intensive and energy-intensive processes may be replaced by closed-loop technologies.

	2020	2025	2030	2035	2040+	never	Responses
	Row %						Count
Production of clean gas and liquid fuels from CO2 (and renewable energy)	8.5%	22.0%	27.1%	22.0%	13.6%	6.8%	59
Integration of energy technologies in a “closed carbon-cycle economy”	3.4%	17.2%	29.3%	20.7%	22.4%	6.9%	58
Recovery of rare earth elements and other materials of value from coal, coal wastes and coal ash	3.4%	25.4%	23.7%	23.7%	16.9%	6.8%	59

Experts propositions:

- CCS

29.Health and safety - The health and safety of workers is the first priority, especially underground workers.

	2020	2025	2030	2035	2040+	never	Responses
	Row %						Count
Remote controlled fire and rescue operations	15.5%	36.2%	31.0%	10.3%	5.2%	1.7%	58
Predicting rock bursts and gas outbursts	19.3%	29.8%	22.8%	15.8%	10.5%	1.8%	57
Safety and worker psychology	34.5%	27.6%	22.4%	6.9%	5.2%	3.4%	58

30.Environmental issues - At all stages in the coal value chain, environmental issues have to be addressed.

	2020	2025	2030	2035	2040+	never	Responses
	Row %						Count
Water management, conservation and treatment	40.7%	32.2%	13.6%	6.8%	6.8%	%	59
Capturing and using methane from mines, including ventilation air methane	23.7%	30.5%	20.3%	11.9%	11.9%	1.7%	59
CO_2 capture, use and storage	17.2%	22.4%	20.7%	19.0%	15.5%	5.2%	58

31.Post-mining and coal asset repurposing - Regions with coal mines and coal power plants have to find solutions for their safe management and use after closure. Imaginative new developments can turn liabilities into assets.

	2020	2025	2030	2035	2040+	never	Responses
	Row %						Count
Low-grade heat recovery and energy storage (e.g. geothermal, compressed air, pumped storage, hydrogen)	8.6%	29.3%	32.8%	19.0%	6.9%	3.4%	58
Use of coal tailings and other mine wastes	10.2%	32.2%	27.1%	15.3%	8.5%	6.8%	59
Evaluation of new business models	24.1%	20.7%	31.0%	6.9%	12.1%	5.2%	58