



UNIVERSITY OF TARTU



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# Should Zero Emission Cars be made Compulsory ? Is it feasible ?



## Assessment

This guide to assessment strategies is put forward from different perspectives. In part A the assessment is based on the skill to be developed in the student. Part B is based on the assessment strategies to use in each lesson, whereas part C illustrates the assessment by the 3 different approaches which a teacher may use for formative assessment – observation, by oral communication, or by marking of written work. Summative assessment strategies are not shown, but these could relate to viva type oral communication and/or to the marking of written tests/examination questions.

## Part A For Assessment of Application of the Skills

### Awarding a Mark for Socio-scientific Decision Making

The ability of a student to undertake a decision making exercise can be assessed by their participation in the decision making exercise on the advertisement.

- x The student was unable to put forward a decision based on the investigational findings and the discussion
- √ The student was able to put forward a decision, but the justification of the decision was poor without the help of the teacher.
- √√ The student was able to put forward a decision, and to well justify this with sound arguments

### Awarding a Mark for Process Skills

The ability of the student to gather information for a variety of sources and to undertake an investigation can be determined by the teacher through the data obtained and the manner in which the student is involved in the investigations.

- x Not willing to obtain useful information and participate in the investigation

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- √ Able to gather useful information with the guidance of the teacher and undertake investigations as a member of a group
- √√ Able to gather information from a wide variety of sources and to successfully undertake a number of investigations

### Awarding a Mark for Personal Skills

- x Not willing to cooperate with others nor able to participate effectively in the group work
- √ Able to play an active role in carrying out group work and in cooperating as a member of a group.
- √√ Able to play a leading role in group work and in helping others in the group to cooperate and communicate effectively.

### Awarding a Mark for Conceptual Skills

- x Not able to explain the production and reactions of hydrogen, nor the working of a fuel cell.
- √ Able to explain that hydrogen will react with oxygen to produce water. Able to explain ways for the production of hydrogen (at least by the electrolysis of water).
- √√ Able to explain that hydrogen will react with oxygen in air, or by electron transfer in a fuel cell, to produce water. Able to explain ways for the production of hydrogen and recognise that an important source of hydrogen is the cracking of petroleum. Able to explain that all engines give emissions and that the hotter the temperature, the more the production of oxides of nitrogen becomes a problem.

## Part B Assessment by Lesson

### Lesson 1

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√) per student or group
1	Creates questions for further investigation regarding the scenario.	Puts forward appropriate questions during groupwork.	
		Able to presents questions to other groups.	
2	Discussion within a group on the fuel for a zero emission car.	Contributes to the group discussion and able to put forward ideas.	
		Cooperates with others in a group by agreeing or commenting on the views of others.	

		Illustrates leadership skills – guiding the group by thinking creatively and helping those needing assistance; summarising outcomes.	
		Shows tolerance with, and gives encouragement to, the group members.	
		Draws appropriate conclusions related to the research/scientific question.	
3	Answers oral questions from the teacher addressed to the individual.	Provides correct oral answers to questions given orally by the teacher on ways that hydrogen might be obtained.	
		Provides answers in sufficient detail on the pollution problem with current fuels, including cars running on electricity.	

## Lesson 2

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√) per student or group
1	Writes a plan and a procedure for an investigation to produce hydrogen.	Puts forward potential sources of hydrogen.	
		Devises an appropriate plan to produce hydrogen and can give explanations for its formation.	
		Develops an appropriate procedure (including apparatus/chemicals required and safety procedures required) and indicates variables to control.	
2	Collaborates in a group in seeking information.	Contributes to the group work during the inquiry phases in suggesting sources of information.	
		Seeks sources of information for the group.	
		Illustrates leadership skills – guiding the group by thinking creatively and helping those needing assistance (cognitive or psychomotor); summarising outcomes.	

### Lesson 3

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√) per student or group
1	Develop a procedure during the group work for the investigation and the testing of the product.	Develops an appropriate procedure (including apparatus/chemicals required and safety procedures required) and indicates variables to control.	
2	Record experimental data collected.	Records observations appropriately.	
3	Answering oral questions asked by the teacher to the group.	Able to explain the work of the group and the actions undertaken by each member.	
		Understands and can explain the science involved using appropriate language.	
		Willing to support other members in the group in giving answers when required.	
4	Answer to oral questions to individuals in the group.	Able to explain the work of the group and actions taken by each member.	
		Understands the purpose of the work and shows knowledge and understanding of the subject using appropriate scientific language.	
		Can exhibit non-verbal activity (demonstrate) in response to the teacher's questions, as appropriate.	

### Lesson 4

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√) per student or group
1	Presenting the investigation or experiment orally.	Presents outcomes for the production of hydrogen by the various approaches with explanations related to the reactivity series, half cells and the tow stage breakdown of water using natural gas.	
		Presents by illustrating knowledge and understanding of the subject.	
		Uses precise and appropriate scientific terms and language.	

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		Presents with clarity and confidence using an audible voice.	
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## Lesson 5

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√) per student or group
4	Answers questions.	Recognises different ways of storing hydrogen and justify the most appropriate method.	
		Record problems in using hydrogen as a fuel.	
		Illustrates, using models, the making of ammonia industrially from hydrogen using the Haber process.	
		Presents graphically the flammability of hydrogen.	
		Provides full and appropriate illustration for the working of a fuel cell.	

## Lesson 6

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√) per student or group
1	Creates a Report.	Makes a detailed report of all activities undertaken and the underlying scientific interpretation.	
2	Presenting the usefulness of hydrogen.	Makes the presentation in a clear and practical manner with justified decisions.	
		Presents by illustrating knowledge and understanding of the subject.	
		Uses precise and appropriate scientific terms and language.	
		Presents with clarity and confidence using an audible voice.	

## Lesson 7

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√) per student or group
1	Functioning in the group during experimentation or discussion.	Contributes to the group discussion on whether zero emission cars should be made compulsory	
		Illustrates leadership skills – guiding the group by thinking creatively and helping those needing assistance.	
		Shows tolerance with, and gives encouragement to, the group members.	
2	Scientific or socio-scientific reasoning.	Able to give a justified, socio-scientific decision to whether zero emission cars should be made compulsory, highlighting the scientific component	

## Part C Assessment by Method

### Assessment Tool based on the Teacher's Marking of Written Material

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√) per student or group
1	Creates questions for further investigation regarding the scenario.	Puts forward appropriate questions during groupwork.	
		Able to presents questions to other groups.	
2	Writes a plan and a procedure for an investigation to produce hydrogen.	Puts forward potential sources of hydrogen.	
		Devises an appropriate plan to produce hydrogen and can give explanations for its formation.	
		Develops an appropriate procedure (including apparatus/chemicals required and safety procedures required) and indicates variables to control.	
3	Develop a procedure during group work for the investigation and the testing of the product.	Develops an appropriate procedure (including apparatus/chemicals required and safety procedures required) and indicates variables to control.	

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4	Record experimental data collected.	Records observations appropriately.	
5	Answers questions.	Able to recognise different ways of storing hydrogen and justify the most appropriate method.	
		Able to record problems in using hydrogen as a fuel.	
		Illustrate, using models, the making of ammonia industrially from hydrogen using the Haber process.	
		Able to present graphically the flammability of hydrogen.	
		Able to provide full and appropriate illustration of the working of a fuel cell.	
6	Create a report.	Makes a detailed report of all activities undertaken and the underlying scientific interpretation.	
7	Scientific or socio-scientific reasoning.	Able to give a justified, socio-scientific decision to whether zero emission cars should be made compulsory, highlighting the scientific component.	

### Assessment Tool based on the Teacher's Oral Questioning

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√) per student or group
1	Answer oral questions from the teacher to the individual.	Provides correct oral answers to questions given orally by the teacher on ways that hydrogen might be obtained.	
		Provides answers in sufficient detail on the pollution problem with current fuels, including cars running on electricity.	
2	Answer oral questions asked to the group.	Able to explain the work of the group and the actions undertaken by each member.	
		Understands and can explain the science involved using appropriate language.	
		Willing to support other members in the group in giving answers when required.	
3	Answering oral questions to individuals in the group.	Understands the purpose of the work and shows knowledge and understanding of the subject using appropriate scientific language.	

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		Can exhibit non-verbal activity (demonstrate) in response to the teacher's questions, as appropriate.	
		Able to explain the work of the group and the actions undertaken by each member.	

## Student Assessment Tool based on the Teacher's Observations

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√) per student or group
1	Discuss in a group on the fuel for a zero emission car.	Contributes to the group discussion and able to put forward ideas.	
		Cooperates with others in a group by agreeing or commenting on the views of others.	
		Illustrates leadership skills – guiding the group by thinking creatively and helping those needing assistance (cognitive or psychomotor); summarising outcomes.	
		Shows tolerance with, and gives encouragement to, the group members.	
		Draws appropriate conclusions related to the research/scientific question.	
2	Collaborate in a group on seeking information.	Contributes to the group work during the inquiry phases in suggesting sources of information.	
		Seeks sources of information for the group.	
		Illustrates leadership skills – guiding the group by thinking creatively and helping those needing assistance (cognitive or psychomotor); summarising outcomes.	
3	Presenting the investigation or experiment orally.	Presents outcomes for the production of hydrogen by the various approaches with explanations related to the reactivity series, half cells and the tow stage breakdown of water using natural gas.	
		Presents by illustrating knowledge and understanding of the subject.	





		Uses precise and appropriate scientific terms and language.	
		Presents with clarity and confidence using an audible voice.	
4	Presenting the usefulness of hydrogen.	Makes the presentation in a clear and practical manner with justified decisions.	
		Presents by illustrating knowledge and understanding of the subject.	
		Uses precise and appropriate scientific terms and language.	
		Presents with clarity and confidence using an audible voice.	
5	Functioning in a group during discussion.	Contributes to the group discussion on whether zero emission cars should be made compulsory.	
		Illustrates leadership skills – guiding the group by thinking creatively and helping those needing assistance.	
		Shows tolerance with, and gives encouragement to, the group members.	