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A Report on the E-C Translation Practice of *Basic Fundamentals to Advanced Concepts of Automobile Engineering*(Chapter 2)

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A Report on the E-C Translation Practice of *Basic Fundamentals to Advanced Concepts of Automobile Engineering*(Chapter 2)

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In English Translation

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摘 要

笔者节选了帕布(Prahbu TL)所著的《车辆工程基本原理与先进理念》(*Basic Fundamentals to Advanced Concepts of Automobile Engineering*)第二章作为翻译文本并以此撰写翻译实践报告,对翻译中遇到的问题进行分析并探寻解决方案。第二章主要介绍了电车电机和新材料的使用、电车电池现状与未来发展态势、尾气排放标准及汽车轻量化的进程。本书用词准确专业;语言客观中立,句式简洁明了,文本结构清晰、有条理。根据赖斯的文本类型理论,可以确认原文为信息型文本。对于这种类型的文本翻译,译者遵循严复信达雅的翻译标准标准,努力保持对原作内容的忠实完整传达,确保原文与译文在语义、句义、语言风格等方面保持一致。

在翻译过程中,半技术词处理、句子结构重组及章节逻辑可视化是重难点。在翻译过程中,译者通过语境辨别词汇细微差别,根据词汇所在领域确定其义;句子重组主要是处理被动语态和调整句子重心,有效传达原文的信息;通过使用重复和替代手段彰显章节逻辑,确保译文与原文保持相同的连贯性和清晰性。

通过此次翻译实践,译者首先对汽车工程有了更深的理解,其次也认识到要根据中英文表达习惯对译文进行适当调整的重要性。同时,笔者希望本翻译实践报告能为同类型文本翻译提供参考。

关键词:《车辆工程基本原理与先进理念》;信息型文本;电车电池;半技术词;语篇衔接

Abstract

The translator chose chapter 2 of the Basic Fundamentals to Advanced Concepts of Automobile Engineering written by Prahbu TL as the text for translation and subsequently composed a translation practice report to delve into the challenges encountered during the translation process and identify potential solutions. The second chapter of this book mainly introduces the use of electric vehicle motors and new materials, the current situation and future development trend of electric vehicle batteries, exhaust emission standards, and the process of vehicle light weighting. The vocabulary used in this book is accurate and professional, the language is objective and neutral, the sentence structure is concise and clear, and the text structure is clear and organized. According to Reiss' text type theory, it can be confirmed that the original text is informative. For this type of text translation, the translator follows the standards of faithfulness, expressiveness, and elegance proposed by Yanfu and strives to maintain faithful and complete communication of the original content, ensuring consistency in semantics, sentence meaning, language style, and other aspects between the original text and the translated text.

In the translation process, semi technical word processing, sentence structure reorganization, and discourse cohesion visualization are the key and difficult points. During the translation process, the translator identified subtle differences in vocabulary through context and determines its meaning based on the domain in which the vocabulary is located; sentence restructuring mainly involves handling passive voice and adjusting sentence focus to effectively convey the information of the original text; by using repetition and substitution to highlight the logical structure of the text, it ensures that the translation maintains the same coherence and clarity as the original text.

Through this translation practice, the translator has first gained a deeper understanding of automotive engineering, and secondly recognized the importance of making appropriate adjustments to the translation according to Chinese and English expression habits. Meanwhile, the translator hopes that this translation practice report can provide reference for translating similar texts.

Key Words: *Basic Fundamentals to Advanced Concepts of Automobile Engineering*; informative text; electric vehicle batteries; semi technical terms; discourse cohesion

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Chapter 1 Introduction to the Translation Task

1.1 Task Description

The source text of this practice project is Chapter 2 of *Basic Fundamentals to Advanced Concepts of Automobile Engineering,* which has not yet been translated into Chinese. There are 7922 words in the source text (ST) and 13,213 words in the target text (TT), which meets the word count requirement in the ST for the graduation thesis of a master of Translation.

1.2 Brief Introduction of the Source Text

In terms of content, the book consists of 11 chapters with a total of 1377 pages, which is an introduction to automotive engineering. Chapter 2, chosen by the translator, presents the use of electric vehicle engines and new materials, the current situation and future development trend of electric vehicle batteries, exhaust emission standards, and the process of vehicle light weighting.

Automobile engineering plays a key role in promoting social development and economic progress. Therefore, the translator selected this article as the source text to analyze the problems encountered in the translation process and to help people know more about the automobile engineering.

1.3 Aims and Significance

This report primarily employs variational translation methods to delve into and address the challenges encountered during translation practice, aiming to offer valuable insights and guidance for future translation endeavors. The translator aspires that through the thorough analysis and consideration of these issues, it can improve the translator’s translation level and theoretical application ability, make a certain contribution in helping domestic scholars to understand the research status of relevant fields abroad, and breathe new life into domestic research development in the relevant fields.

What’s more, the scientific paper can also help people intensify the perception of history and working principle of automotive electrical and electronic systems, and trigger people’s new thinking on how to handle automobile issues they encounter. Selecting this English paper, with a relatively recent publication date, for translation can effectively introduce foreign automotive concepts to China, prompt individuals to reconsider the future of automotive engineering, and encourage greater attention to safe driving practices.

Chapter 2 Pre-translation Preparations

The initial step in any translation process involves thoroughly analyzing the source text (ST). Only by accurately grasping the domain, language style, and characteristics of the ST can a translator effectively prepare for the selection of appropriate translation theories, the compilation of relevant resources, and the anticipation of potential difficulties in the subsequent translation stages. This analysis enables the translator to formulate targeted translation plans, compile relevant parallel texts, establish terminology databases, and select suitable translation tools. Through this meticulous preparation, the translator aims to lay a solid foundation and provide valuable references for future translation efforts, ensuring a high-quality and accurate translation outcome.

2.1 Characteristic Analysis of the Source Text

The chosen passage is a piece of scientific and technological writing. Scientific and technological texts mainly express facts, information, knowledge, opinions, etc., and their language is characterized by strong logic, and the focus of the text is on the content rather than the form; the translation should convey the same concepts and information as in the original text in simple and clear language.(张美芳, 2009:53). The language used in the source text is informative, with the primary function of conveying information and stating facts or occurrences. So according to Reiss, it belongs to informative text. Each language has its own grammar and usage of vocabulary, and we cannot imagine that a mechanical translation of the original work, word by word and sentence by sentence, in its original structural order, can properly convey the appearance of the original work, nor can we imagine that such a translation would be purely national (宋其昌, 1984:30). Compared with other English genres, scientific and technical English is highly specialized, logically rigorous and structurally compact, so the translator needs to reserve background knowledge of the relevant specialties and pay full attention to the choice of professional vocabulary and the flexible use of different grammars before translation.(温立军, 2020:397) . They abound in professional terminology, with meanings that are relatively fixed and specific. Scientific and technological English is primarily a written language, demanding precision and conciseness to reflect the rapid advancements and innovations in the field of science and technology (Christiane Nord, 2014:2).

Therefore, the translator should follow the standards of faithfulness, expressiveness, and elegance proposed by Yanfu, and strives to maintain faithful and complete communication of the original content, ensuring consistency in semantics, sentence meaning, language style, and other aspects between the original text and the translated text.

2.2 Translation Tools

In numerous translation tasks, practical translation tools serve as invaluable aides in the translation process, offering crucial support in modern translation work. Given the vast array of translation tools available, choosing suitable ones can significantly impact the translation's accuracy. In this translation practice, various tools such as Baidu Translation, ChatGPT, cnki Translation Assistant, etc. were employed. When dealing with ambiguous terms, experts in special fields and Internet resources, including Wikipedia and Baidu Baike, were consulted. Besides, the translator looked up a variety of dictionaries such as the Longman Dictionary of Contemporary English, the Oxford Advanced English-Chinese Dictionary, etc.

2.3 Parallel Texts Collecting and Glossary Building

Parallel texts refer to texts that cover comparable topics but are created in different contexts. Despite their diverse backgrounds, these texts belong to the same genre and fulfill the same objective. In translation theory, Nuebert defines parallel texts as "bilingual texts containing the same information produced in a comparable communicative context" (Nuebert, 1985). Li Changshuan concisely summarizes the broad and narrow interpretations of parallel texts, defining them as "any reference material closely related to the content of the source text" (李长栓, 2012). Utilizing parallel texts plays a crucial role in enhancing both the efficiency and the quality of translation tasks to a significant extent. In this instance, the translator made use of various resources such as the internet and library books to gather relevant parallel text materials related to the translation task. Studying parallel texts provided invaluable insights and exemplars for the translator, enhancing comprehension of terminology, syntax, and style within the scientific and technical domain. This facilitated a smoother, more accurate translation process that adhered to target language conventions. Given the intricate nature of the topic, such as the transition and advancement of the automotive industry, including the practical application of automotive technologies and the integration of intelligent automation in automotive engineering, the translator had to delve deeply into the parallel texts to acquire pertinent professional knowledge. By familiarizing oneself with the relevant terminology and specific expressions, the translator significantly improved translation accuracy, ensuring that the expressions were natural and well-received by the target audience.

To ensure consistency across the translation, a glossary containing frequently used professional terminology was compiled and included in Appendix I. This not only ensured the uniform translation of particular terms but also reduced the translator's workload. Through comprehensive reading of the text, the translator identified prevalent professional vocabulary and phrases, determining their meanings with the aid of online resources like DeepL, Google, and ChatGPT. For challenging terminology, contextual analysis was conducted, comparing them with parallel texts or seeking clarification from mentors and peers to pinpoint their precise meanings. This approach ensured the accuracy and clarity of the translation, reflecting the latest advancements and innovations in the rapidly evolving field of automotive engineering and technology.

Chapter 3 Case Study

Case analysis holds a pivotal role in a translation practice report, serving as its most essential component. This chapter will present illustrative examples and a thorough analysis of the translation process. Throughout the translation practice, the translator encountered several typical, significant, and challenging issues, including the need to adapt commonly used words to a more technical context, the necessity to reshape the source text to conform to the linguistic norms of the target language, and the importance of maintaining a coherent representation of the source text in the translation. Combined theory with practice, the translator adopted "adaptation" "adjustment" and "repetition" to solve these problems properly.

3.1 Specialization of Common Nouns (Semi-Technical Words)

The specialization of common nouns is a prominent feature in English for Science and Technology (EST) texts, posing a significant challenge in scientific translation. Delving into the causes, types, and translation pitfalls of these specialized nouns offers valuable insights into comprehending technical texts and enhancing translation practice in EST. By understanding the nuances of this specialization, translators can more accurately convey the intended meaning and technical details of the source text.

3.1.1 Discerning Subtle Differences of Vocabulary in Context.

When confronted with specialized common words, translators must discern subtle differences in vocabulary based on the context and make careful selections. For instance, in scientific texts, when common nouns are used as specialized terms, translating them in the same way as in everyday language can strip the text of its technical nature, creating obstacles for readers' comprehension. For such vocabulary, translators cannot infer their specialized meanings solely from their original definitions. Instead, they must consider the context of the sentence, identify changes in the meanings, and confirm their technical implications through their own stores of specialized vocabulary.

Example 1:

ST: This inverter converts DC into alternating current(AC) electricity and then it is fed to 3 phase AC induction motor.(Prahbu TL, 2021).

TT1: 该逆变器将直流电转换为交流电，然后输送至三阶段交流感应电机。

TT2: 该逆变器将直流电转换为交流电，然后输送至三相交流感应电机。

Analysis： To translate example 1 properly, the translator should have the background information in physics and electrical engineering. “phase” in example1 has multiple meanings like “a group of words that have a particular meaning when used together,” or “a short series of notes that form a unit within a longer passage in a piece of music” or “stage” etc. Translator should distinguish the most suitable meaning among these explanations. Hence, according to the context, it should be translated as “相” in Chinese instead of “阶段.”

Example 2：

ST: Fuel cell vehicles will have zero emissions unless they use an onboard reformer to process methanol or another fuel into hydrogen.(Pahbu TL, 2021).

TT1: 除非使用车辆改革者将甲醇或其他燃料转化为氢气，否则燃料电池汽车将实现零排放。

TT2: 如果使用车载重整器将甲醇或其他燃料转化为氢气，燃料电池汽车将实现零排放。

Analysis: Similar to example1, “reformer” also has several different meanings: “a person who works to achieve political or social change”, “election law revisionists”;according to the context and the type of text, it is obviously that the example sentence did not mention about cloths, so the translator looked it up through translation tools and finally chose “重整器” as the better vision.

Example 3

ST: Use of lightweight materials in valves, valve springs, and pistons, advanced coatings on pistons and ring surfaces, improved lubricants(Prahbu TL,2021).

TT1: 在阀、阀弹簧和活塞中使用轻质材料，在活塞和活塞环表面使用高级涂层，改进润滑剂。减少机械摩擦。

TT2: 在气门、气门弹簧和活塞中使用轻质材料，在活塞和活塞环表面使用高级涂层，改进润滑剂。减少机械摩擦。

Analysis: “Valve” means “ a device for controlling the flow of a liquid or gas, letting it move in one direction only” and in musical field it also means “a device in some brass musical instruments for changing the note”, as for the “valve” in example 3, its function is similar to the first explanation, but in automobile field, it has a specific and accuracy meaning in Chinese: “气门”

3.1.2 Deriving Extended Meanings through the Basic Meaning

A substantial portion of the modern scientific and technological English vocabulary originates from previously existing common English words through the use of metaphor. Metaphor plays a pivotal role in the creation of specialized terminology in this field, allowing for the innovative and expressive communication of complex scientific concepts. Many technical terms acquire their specialized meanings through extensions of the basic meanings of common words, and these extended meanings often retain some semantic connection to the original words. As a result, translators should infer the specialized meanings of these terms from their original meanings.

Example 4:

ST: To enable small sharp turns to be made smoothly without wheel lock-up occurring even at large steering angles(Prahbu TL, 2021).

TT1: 即使在转向角度较大的情况下，也能平稳地进行小急转弯，而不会出现车轮锁住的情况。

TT2: 即使在转向角度较大的情况下，也能平稳地进行小急转弯，而不会出现车轮抱死的情况。

Analysis: The word “lock” usually refers to a mechanical device used to prevent doors, windows, drawers, boxes, etc. from being opened illegally. In automobile engineering, it usually means the wheels locked and the brake fails. So the translator chose “抱死” in Chinese accordingly instead of “锁住”.

Example 5:

ST: In collisions with roadside obstacles, lighter vehicles have less chance than a heavier vehicle of deforming the obstacle or even running through it, both of which would decrease deceleration forces on the occupants.(Prahbu TL,2021:).

TT1: 在与路边障碍物发生碰撞时，较轻的车辆比较重的车辆更不容易使障碍物变形，甚至撞穿障碍物，而这两种情况都会减少居住者的减速力。

TT2: 在与路边障碍物发生碰撞时，较轻的车辆比较重的车辆更不容易使障碍物变形，甚至撞穿障碍物，而这两种情况都会减少乘员的减速力。

Analysis: “Occupants” in normal text means a person who lives or works in a particular house, room, building, etc. In this sentence, we can easily associate that people who “live” in cars must be the passengers. So the translator translated it as “乘员” in Chinese instead of “居住者”.

Example 6:

ST: Automakers use a various analytical methods (e.g., finite element codes) to calculate the stresses in a structure under specified loading(Prahbu TL, 2021).

TT1: 汽车制造商使用各种分析方法（如有限元代码）来计算结构在特定载荷下的压力。

TT2: 汽车制造商使用各种分析方法（如有限元代码）来计算结构在特定载荷下的应力。

Analysis: “Stresses” normally refers to “pressure or worry caused by problems in somebody’s life or by having too much to do” or “physical pressure put on something that can damage it or make it lose its shape.” But in example 5, stresses mean “When an object is deformed due to an external cause (force, humidity, change in temperature field, etc.), internal forces interacting between the parts within the object, per unit area, are called stresses.” Therefore, the translator should derive the extended meaning through the basic meaning and the proper translation should be “应力” rather than “压力”.

Example 7:

ST: In an electric vehicle, usually direct current (DC) electricity is fed from a battery bank to AC/DC inverter(Prahbu TL, 2021).

TT: 在电动汽车中，直流电通常从电池组馈入交直流逆变器。

Example 8:

ST: The advantage is that unlike AC induction motor which uses electricity to generate the magnetic currents inside the motor(Prahbu TL, 2021).

TT: 其优点在于，交流感应电机使用电力在电机内部产生磁流。

Example 9:

ST: An alternating field induces eddy currents in liquid metal which interact with the field to give a Lorentz body force which is generally rotational and which must, therefore, drive fluid motion(Prahbu TL, 2021).

TT: 交变磁场会在液态金属中产生涡流，涡流与磁场相互作用，产生洛伦兹力，洛伦兹力是旋转的，因此必须驱动流体运动。

Analysis: From example 7-9, we can find out that each sentence involved the word “current” which is a common noun. Common nouns have different specialized meanings in different fields of science and technology, that is, the so-called word has multiple meanings, both common and different specialized meanings. In these examples, current has different meanings, so the translator should decide the most accurate one according to the field it belongs to.

Therefore, the translator, based on the specific field, translated them as “直流电” “磁流” “涡流” accordingly.

3.2 Transformation and Rearrangement of Sentence Structure

There are great differences in sentence structure between English and Chinese. English pays attention to hypotaxis. Sentence structure can be extended and combined with various means of connection to form long and complex sentences. However, Chinese emphasizes parataxis, drives form by meaning, and has loose sentence structure. The sentences are often short and pithy, but the meanings are clearly layered. Therefore, when translating English long sentences into Chinese, it is often necessary to adopt flexible means such as amplification, omission, inversion, etc. In addition, in English for science and technology, passive sentences are widely used in order to objectively record some phenomena and conclusions and avoid subjective expression. Under the premise that there are great differences between the expression modes of English and Chinese, translators must choose the language that conforms to the expression habits of the target text to express the translation, so as to make the logical level of the target text clear and the language smooth and natural.

3.2.1 Adaptation of Passive Meaning

Adaptation in translation often involves converting the passive voice in English texts to the active voice in Chinese. This is particularly true in scientific and technical articles, where English frequently employs the passive voice. Conversely, Chinese prefers the active voice, reflecting the unique expressive characteristics of each language. By adjusting the voice in translation, we ensure that the translated text reads naturally and accurately captures the intended meaning of the original text.

Example 10:

ST: The key performance parameters for electric vehicle batteries <u>are discussed</u> in succeeding paras.(Prahbu TL, 2021).

TT1: 电动汽车电池的关键性能参数将在下文中<u>被讨论</u>。

TT2: 下文将讨论电动汽车电池的关键性能参数。

Analysis: There is only one passive meaning in this sentence, it is not difficult for the translator to figure out the logical relationship of this sentence. “The key performance parameters are discussed.” it is literally translated as “关键性能参数被讨论。” This translation is not in line with the Chinese expression habits, so the translator here translated this sentence into “讨论关键性能参数”

Example 11：

ST: It is connected electrically in series so that equi-distribution of current will take place and thermally in parallel so that heat conduction is properly maintained.(Prahbu TL, 2021).

TT1: 模块的电气连接被串联起来，以实现电流的均衡分配；采用并联方式进行热连接，热的传导将被以正常方式进行。

TT2: 模块采用串联方式进行电气连接，以实现电流的均衡分配；采用并联方式进行热连接，以确保热传导正常进行。

Analysis: The sentence is a complex sentence containing two adverbial clauses of result. In the main clause and subordinate clause, there is one passive respectively: “It is connected electrically” and “heat conduction is properly maintained”. The translator did not translate it into “被串联起来，以实现电流的均衡分配” or “热的传导将被以正常方式进行” but into “用串联方式进行电气连接，以实现电流的均衡分配” and “以确保热传导正常进行” In this way, the translation conforms to the Chinese expression habits, and the readability is thus increased.

3.2.2 Adjustment of Long sentences

English tends to favor longer sentences, while Chinese prefers shorter ones. Therefore, when translating from English to Chinese, merely adhering to the original long sentence structure can lead to awkward and unnatural translations, and we have to break up the long sentences according to the sense group, narrate them separately, and reorganize the short sentences in the translation. When the original English sentences are long and complex, we can break the constraints of English sentence pattern and reorganize the sentences according to the chronological or logical order to make the translation smooth.

Example 12:

ST: OTA’s evaluation of lifecycle costs leads to the conclusion that their influence will offset sharply higher purchase prices only under limited conditions. (Prahbu TL, 2021).

TT1: OTA 对生命周期成本的评估得出的结论是生命周期成本的影响只有在有限的条件下才能抵消大幅提高的购买价格。

TT2：OTA 对生命周期成本的评估得出的结论是，只有在有限的条件下，生命周期成本的影响才能抵消大幅提高的购买价格。

Analysis: This sentence is a complex sentence. The main clause is “OTA’s evaluation of lifecycle costs leads to the conclusion” and the subordinate clause is “that their influence will offset sharply higher purchase prices …”, which is an appositive clause that modifies the word “conclusion”. “only under limited conditions” is a prepositional phrase acting as conditional adverbial. In TT1, the sentence is translated according to the original word order, which is not in line with the Chinese expression habit. It is customary to put the conditions ahead in Chinese, so in TT2, the phrase guided by “under” was placed forward, and the translation can be logical, hierarchical, and more fluent.

Example 13:

ST: Each of the advanced vehicles examined by OTA have emission characteristics that are different from current vehicles as well as from the baseline (business-as-usual) vehicles expected to enter the fleet, if there are no new incentives for significant changes in vehicle technology.(Prahbu TL, 2021).

TT1: OTA 研究的先进车辆的排放特性都不同于当前的车辆，也不同于预计将进入市场的（照常出售）车辆如果没有新的激励措施来促进车辆技术的重大变革。

TT2: 如果没有新的激励措施来促进车辆技术的重大变革，那么 OTA 研究的先进车辆的排放特性都不同于当前的车辆，也不同于预计将进入市场的（照常出售）车辆。

Analysis: This sentence is a complex sentence, and the conditional clause led by if indicates that the content of the main clause is established when a specific condition is met. In TT1, it is not smooth to translate according to the original order. In Chinese, it is customary to mention the condition first. Therefore, the translator rearranged the order of the original English sentence, translating the conditional clause led by "if" first and then describing the situation when the condition is met. By doing so, the translation becomes clearer and more organized, adhering to the idiomatic structure of Chinese language.

Example 14:

ST: The key emissions advantage of EVs is that they have virtually no vehicular emissions regardless of vehicle condition or age -- they will never create the problems of older or malfunctioning “super-emitters,” now a significant concern of the current fleet.(Prahbu TL, 2021).

TT1: 电动汽车的主要排放优势在于无论车辆状况或车龄如何它们几乎没有车辆排放物--它们永远不会产生老旧或故障的 "超级排放器 "问题，这正是当前车辆的一个重要问题。

TT2: 电动汽车的主要排放优势在于，无论车辆状况或车龄如何，它们几乎没有排放物--它们永远不会产生老旧或故障的 "超级排放器 "问题，而这正是对先进车辆排放的主要担忧。

Analysis: One of the features of scientific and technical texts is the use of long sentences, but compared with Chinese long sentences, English long sentences seem to be more complex. This is because Chinese tends to break down long sentences into small sentences, which only express one layer of meaning within a small sentence, while English long sentences sometimes contain multiple layers of meaning. Hence, when translating long sentences in English scientific and technical texts, it is imperative to adapt the sentence structure to ensure a smooth and accurate translation through breaking and reorganization(divide "电动汽车的主要排放优势在于无论车辆状况或车龄如何它们几乎没有车辆排放物" into "电动汽车的主要排放优势在于，无论车辆状况或车龄如何，它们几乎没有排放物。"), so that the sentence can be translated into several independent sentences of shorter length under the condition of keeping the original meaning intact.

3.3 Means of Discourse Cohesion

Scientific and technical English discourse includes scientific and technical essays, laboratory reports, operating procedures for introducing scientific and technical trends and experiments, as well as discourse describing and explaining the phenomena of nature, etc. The distinctive characteristic of scientific and technical English discourse lies in its emphasis on coherence, clarity and fluency of the text, and expresses scientific facts through strict logic and objective description. Consequently, when translating scientific and technological texts, the primary emphasis should be on the accurate conversion of information between the source and target languages. Discourse cohesion can guarantee that the stylistic nuances of the original text are faithfully reproduced in the translated version, while maintaining harmony in tone and format. To achieve discourse cohesion, some devices should be adopted such as repetition of key words and substitution.

3.3.1 Repetition of Key Words

Example 15

ST: For small range and slow speed application of electric vehicle, even brushless DC motor is also used. The electrical energy is converted into mechanical energy through motor and fed to wheels through transmission and differential. Normally, it is said that inverter is the brain and motor is heart of the electric vehicle.(Prahbu TL, 2021).

TT: 对于小范围和低速应用的电动汽车，甚至也使用无刷直流电机。电能通过电机转换为机械能，再通过变速器和差速器输送到车轮。通常，逆变器是电动汽车的大脑，而电机则是心脏。

Analysis: This chapter is about the “Motor Technology”. The repetition of “motor” in the original text makes the whole text closely connected and introduces the function of Motor Technology to the readers accurately and clearly, while the translation also catches the key words and repeats them accordingly, which successfully reproduces and retains the original text's articulation, and achieves the effect that the original text is intended to express.

Example 16

ST: Normally, the value chain of electric vehicle batteries consists of raw material for production, cell production, module production, assembly of modules into the battery pack, integration of the battery pack into the vehicle, use during the life of the vehicle, and reuse and recycling. Lithium-ion batteries comprise a family of battery chemistries that employ various combinations of anode and cathode materials. The most prominent technologies for automotive applications are lithium-nickel-cobalt-aluminium(NCA),Lithium-nickel-manganese-cobalt(NMC),Lithium-manganese spinel(LMO), Lithium titanate(LTO) and Lithium-ion phosphate (LFP).(Prahbu TL, 2021).

TT: 通常，电动汽车电池的价值链包括生产原料、电池生产、模块生产、将模块组装成电池组、将电池组集成到汽车中、在汽车寿命期内使用以及再利用和回收。锂离子电池由一系列采用不同正负极材料组合的电池化学成分组成。

Analysis: Through the analysis, it can be seen that “battery” and “cell” in the original language are two anagrams of near-synonyms, which constitute a close articulation of the original language, and at the same time, these two words have their own Chinese word “电池” with exactly the same meaning to correspond to them, so the Chinese translation adopts repetition to achieve discourse cohesion.

3.3.2 Substitution

Sometimes discourse cohesion is characterized by simplicity and achieved by substitution, therefore, pronouns are usually used in English discourse to replace the same part of the previous text. When translating into Chinese, in order to avoid confusion and misunderstanding, sometimes the corresponding noun referred to by the pronoun should be repeated to make the translation clearer and more explicit.

Example 17

ST: One key advantage for some hybrids will be their ability to run in an EV-mode in cities, although their performance or range may be limited in this mode. Other advantages are less certain, however. Hybrids will likely not run at constant speed, although their speed and load excursions will be less than with a conventional vehicle; they must cope with cold start and evaporative emissions essentially similar to a conventional vehicle; and their engines may be stopped and restarted several times during longer trips, raising concerns about increased emissions from hot restarts. In OTA’s view, hybrid vehicles with substantial EV range have clear emission advantages in this mode, but advantages in normal driving are unclear.(Prahbu TL, 2021).

TT: 混动车的优势之一是能够在城市中以电动模式行驶，尽管此种模式下性能或续航里程可能会受到限制。不过，其他优势就不那么确定了。混合动力汽车可能不会以恒定的速度行驶，尽管其速度和负载偏移将小于传统汽车；它们必须应对与传统汽车基本类似的冷启动和蒸发排放问题；在较长的行程中，它们的发动机可能会多次停止和重新启动，这引起了人们对热启动导致排放增加的担忧。OTA 认为，电动汽车续驶里程大的混合动力汽车在这种模式下具有明显的排放优势，但在正常行驶中的优势并不明显。

Analysis: The original discourse is a referential cohesion, in which the sentences use "this mode" to refer "EV- mode", so the original text is concise, and the relationship between the previous and the next is very clear. The translation, on the other hand, first translated the "EV-mode" literally and then used "此种模式" and "这种模式" to replace the same word according to the Chinese expression habit, which is not only in line with the Chinese vocabulary articulation habit, but also makes the expression of the translation more accurate and clearer.

Example 18

ST: Any adverse safety impacts, however, are unlikely to be nearly so severe as those that occurred as a result of changes in the size and weight composition of the new car fleet in 1970 to 1982. The National Highway Traffic Safety Administration concluded that those changes "resulted in (net) increases of nearly 2,000 fatalities and 20,000 serious injuries per year." Many of those adverse impacts occurred because vehicles changed in size as well as weight, however, yielding reduced crush space, reduced track width and wheelbase (which increased the incidence of vehicle rollovers), and so forth.(Prahbu TL, 2021).

TT: 不过，任何不利的安全影响都不可能像 1970 年至 1982 年新车车队的尺寸和重量构成变化所造成的影响那么严重。美国国家公路交通安全管理局的结论是，这些变化 〞导致每年（净）死亡人数增加近 2000 人，

重伤人数增加 2 万人。″然而，这些不利影响中有许多是因为车辆的尺寸和重量发生了变化，导致挤压空间减少、轨道宽度和轴距减少（增加了车辆侧翻的发生率）等等。

Analysis: In the original text, the phase “those changes”, refers to the sentence “Any adverse safety impacts, however, are unlikely to be nearly so severe as those that occurred as a result of changes in the size and weight composition of the new car fleet in 1970 to 1982.” In the above text, it is in line with the expression habit of the English language. In order to make the translation clearer and more accurate, the sentence has been replaced by the pronouns, which is in line with the expression habit of Chinese.

Chapter 4 Summary

4.1 Proofreading

Proofreading is actually a process of deepening understanding, as well as the process of improving and guaranteeing the quality of translation. Proofreading can be divided into the primary steps of checking and correcting errors and the advanced steps of polishing the translation:

When the translation is completed, self-checking is carried out first, the translator carefully compared the understanding of the source text with the expression of the translated text, paying much attention to the accuracy and faithfulness. It includes whether there is any message missing in translation or any mistranslation, whether the expressions of proper nouns and professional terms are accurate, and whether the long sentences are appropriately translated, etc. After the initial proofreading, the translation is submitted to my teammates, teachers and professionals for a second review. The purpose is to further check for the inappropriate understanding or expressions in translation and improve the translation quality.

To polish the language in the target text, the translator checked grammar and punctuation, adjusted vocabulary and optimized sentence structure, making them more authentic, fluent, and accessible to the target audience.

4.2 Gains

During the translation practice, the translator has garnered profound insights and accumulated rich experience, realizing that translation is far from being a straightforward or mechanical process. Instead, it is an intricate and nuanced art that demands meticulous attention to detail and a deep understanding of both source and target languages. Through this practice, the translator has identified numerous challenges and weaknesses, and will improve from the following points:

Solid basic language skills are the most basic requirements for a translator. The translator must continuously enhance his bilingual proficiency in Chinese and English. Additionally, he must become acquainted with the nuances in expression and logical thinking that exist between the two languages. Mastering the ability to fluidly alternate between Chinese and English expressions is pivotal in translation. It enables a more accurate and natural rendition that faithfully preserves the original meaning and stylistic nuances of the source text. This demands a profound comprehension of both languages and their respective cultural backgrounds, coupled with a meticulous eye for detail.

Theories and methods in translation can offer valuable direction for practitioners, aiding them in addressing translation challenges with greater efficacy. By delving into these theories, translators can enhance their understanding and elevate their translation skills. Engaging in translation work highlights the translator's deficiency in scientific and technological understanding, thereby affecting the quality of translations. As a result, it is imperative for translators to expand their expertise in specialized domains to ensure greater accuracy and precision in future translations.

4.3 Limitations

The original text highlights the challenge posed by the abundance of scientific and technological content in the source material, which the translator may not fully comprehend. To bridge this gap, the translator must conduct thorough research and analysis, consulting various resources to grasp the intended meaning. However, due to the vast scope of automobile engineering, the translator's background knowledge might not cover all relevant areas, leading to potential inaccuracies or lack of professionalism in the translations. Despite the translator's efforts to convey the message faithfully, mistakes may occur due to insufficient professional knowledge. Furthermore, the translator's bilingual skills may not be robust enough, particularly when faced with unfamiliar terminology, requiring assistance from teachers or peers to accurately convey meanings. Complex English sentences pose an additional challenge, sometimes necessitating extra time for deconstruction and interpretation. While the semantic logic of English sentences may be understood, the natural and smooth translation into Chinese remains difficult for the translator. Consequently, flaws may exist as the translator struggles to find appropriate Chinese expressions. Additionally, the translator's limited grasp of translation theories and techniques further complicates the process, hindering their effective application.

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Appendix I: Glossary

序号	英文	中文
1	Anti-lock Braking System (ABS)	防抱死制动系统
2	Pole Wheel	棘轮
3	Wheel Hub	轮毂
4	Magnetic Sensor	磁传感器
5	Electrical Pulse	电脉冲
6	Electronic Control Unit (ECU)	电子控制单元
7	Adaptive Cruise Control (ACC)	自适应巡航控制
8	Brake Chamber	制动气室
9	Brake Pedal	制动踏板
10	Wheel Speed Sensor	轮速传感器
11	Permanent Magnet	永磁体
12	Sheathing	包板
13	EPDM	三元乙丙橡胶
14	Polyurethane	聚氨酯
15	Exhaust Break	排气制动器
16	Modulator Valve	调节阀
17	Interlock Connector	联锁连接器
18	Brake Valve	制动阀
19	Inlet Port	进气口
20	Delivery Port	出气口
21	Exhaust Passage	排气通道
22	Quick Release Valve	快放阀
23	Relay Valve	中继阀
24	Brake Pedal	制动踏板
25	Reservoir	储气罐
26	Instrument Panel	仪表盘
27	Flashes	闪蒸现象/闪烁
28	Off Highway Switch	非高速开关

29	Blink Code Switch	闪烁代码开关
30	Radar Headway Sensor	雷达测距传感器
31	Digital Signal Processor	数字信号处理器
32	Longitudinal Controller	纵向控制器
33	Infrared Sensor	红外传感器
34	Sweep Long-range Sensor	长距离扫描传感器
35	Solid-state Gyro	固态陀螺仪
36	Vehicle Application Controller	车辆应用控制器
37	Throttle	节流阀
38	Transmission	变速器
39	Accelerator	加速器
40	Timing Pulse	正时脉冲
41	Throttle Setting	节流阀调定
42	Controller Area Network	控制器局域网
43	ACC Module	自适应巡航模块
44	Instrument Cluster	仪表盘
45	Checksum	校验和
46	Cruise Switch	巡航开关
47	Common Rail	共轨管线
48	Fuel Injector	燃油喷射器
49	Injection Cycle	充注周期
50	Crankshaft	曲轴传感器
51	Euro V	欧 V 标准
52	Timing Cam	正时凸轮
53	Hydraulically Operated Common	液压共轨柴油发动机
54	Constant-pressure Turbocharged	恒压涡轮增压发动机
55	Piezoelectric Valve	压电阀
56	Fuel Atomisation	燃油雾化
57	"Pilot" Injection	预喷射/先导喷射
58	Cold Starting	冷启动
59	Unit Injection System	单元喷射系统

60	Inline Pump System	管道泵系统
61	Distributor Pump System	分配泵系统
62	Unit Injector	泵喷嘴
63	Plunger	柱塞
64	Preload	预载荷
65	High-pressure Pump	高压泵
66	Pressure Accumulator	蓄压器
67	Nozzle	喷嘴
68	Cylinder	气缸
69	Torque	力矩
70	Complete Combustion	完全燃烧
71	Digital Twin Spark Ignition System (DTSI)	数字式双火花塞点火系统
72	Spark Advance	点火提前角
73	Electronic Control Box	电子控制箱
74	Valve Timing	气门正时
75	Power-to-weight Ratio	比功率
76	Four-stroke	四冲程
77	Two-stroke	二冲程
78	Idling Speed	怠速
79	Over Boost	超增压
80	Ignition Distributor	点火分电器
81	Twin Overhead Cam	双顶置凸轮
82	Microprocessor	微处理器
83	Ignition Timing	点火正时
84	Piston Rings	活塞环
85	Valve Stem	阀杆
86	Thermal Efficiency	热效率
87	Compression Ratio	压缩比
88	Electromagnetic Brake	电磁制动器
89	Electromagnetism	电磁原理

90	Heat Loss	热损失
91	Magnetic Flux	磁通
92	Eddy Current	涡流
93	Rotor	转子
94	Exhaust Brake	排气制动器
95	Retarders	缓速器
96	Friction Brake	摩擦制动器
97	Brake Lining	制动衬片
98	Brake Fade	制动失效
99	Gearbox	变速器
100	Rear Axle	后轴
101	Rheostat	变阻器
102	Stator	定子
103	Anti-Vibration Mountings	抗震支架
104	Fins	散热片
105	Rigid Vehicle	刚性车辆
106	Dissipation Capability	散热能力
107	Compressor	压气机
108	Crane	起重机
109	Winch	绞车
110	Lift	升降机
111	Turbocharger	涡轮增压器
112	Naturally Aspirated Engine	自然吸气发动机/ 不增压发动机
113	Intake Air	进气
114	Otto Cycle	奥托循环
115	Diesel Cycle	狄塞尔循环
116	Volumetric Efficiency	容积效率
117	Intake Valve	进气阀
118	Torque Output	扭矩输出

119	Crankshaft	曲轴
120	Centrifugal Supercharger	离心式增压器
121	Waste Gate	废气旁通阀
122	Garrett-Turbocharged	加勒特涡轮增压
123	Particulates	悬浮颗粒物
124	NOx	碳化物
125	Low Emission Zone	低排放区
126	Internal Combustion Engine (ICE)	内燃机
127	On-Board	车载
128	Fuel Cell(FC)	燃料电池
129	Propulsion System	推进系统
130	Diesel Hybrid Bus	柴油混合动力公交车
131	Diesel Engine	柴油发动机
132	Hybrid System	混动系统
133	Series	串联
134	Parallel	并联
135	Drivetrain	传动系统
136	Decouple	解耦
137	Speed-torque Map	速度扭矩图
138	Regenerative Braking	再生制动
139	Idling	空转
140	Kinetic Energy	动能
141	Electric Motor	电机
142	Drive System	驱动系统
143	PM Filters	PM 过滤器
144	Fuel Economy	燃油经济型
145	Ni-MH	镍氢
146	Lithium Batteries	锂电池
147	Li-ion	锂离子
148	Lithium Polymer (LiPo)	锂聚合物
149	Lithium-Iron-Phosphate (LiFePO4)	磷酸铁锂

150	Supercapacitor	超级电容器
151	Cycle Life	循环寿命
152	Range	续航里程
153	Overhead Cables	架空电缆
154	Plug-in (Conductive)	插入式（传导）
155	Wireless (Inductive)	无线式（感应）
156	Catenary (Overhead Power Lines)	悬链线（架空电力线）
157	Power Cord	电源线
158	Intermediate Stops	中间站
159	Proton Exchange Membrane Fuel Cell (PEMFC)	质子交换膜燃料电池
160	Solid Oxide Fuel Cells (SOFCs)	固体氧化物燃料电池
161	Transient Power	瞬时功率
162	Fuel Cell Stack	燃料电池堆
163	Electrolysis	电解
164	Electric Vehicle	电动汽车
165	Direct Current (DC)	直流电
166	Battery Bank	电池组
167	AC/DC Inverter	交直流逆变器
168	Alternating Current (AC)	交流电
169	3-phase AC Induction Motor	三相交流感应电机
170	Brushless DC Motor	无刷直流电机
171	Differential	差速器
172	Traction Motor	牵引电机
173	Induction Motor	感应电机
174	Internal Magnet	内部磁体
175	Magnetic Flux	磁通
176	Sine Distribution	正弦分布
177	Magnetization Currents	磁化电流
178	Heating	发热
179	Permanent Magnet Electric Motor	永磁电机

180	AC Induction Motor	交流感应电机
181	Magnetic Currents	磁流
182	Rare-Earth Materials	稀土材料
183	High Performance Cars	高性能汽车
184	Square Copper Wires	方形铜线
185	Round Wires	圆形铜线
186	Alternating Magnetic Field	交变磁场
187	Nesting	嵌套
188	Compactness	紧凑性
189	Torque Improvement	扭矩提升
190	Daido Steel	日本大同钢
191	Neodymium Magnet	钕磁铁
192	RPM (Revolutions Per Minute)	每分钟转速
193	High RPM Motors	高转速电机
194	Electromagnetic Stir Casting	电磁搅拌铸造
195	Hybrid Metal Matrix Composite (MMC)	混合金属基复合材料
196	Metal Matrix Composite (MMC)	金属基复合材料
197	Organic Compound	有机化合物
198	Hybrid MMC	混合金属基复合材料
199	Defense Industry	国防工业
200	Aviation Industry	航空工业
201	Aerospace Industry	航天工业
202	Characterization	表征
203	Hybrid Aluminium MMC	混合铝金属基复合材料
204	Microstructural Morphology	微观结构形态
205	Tribological Properties	摩擦学性能
206	Reinforcement Material	增强材料
207	Al2O3	氧化铝
208	SiC	碳化硅
209	BN	氮化硼
210	B4C	四硼化碳

211	AlN	氮化铝
212	TiB2	二硼化钛
213	Graphite	石墨
214	Eddy Currents	涡流
215	Lorentz Body Force	洛伦兹力
216	Fluid Motion	流体运动
217	High-Frequency Limit	高频极限
218	Narrow Layer	狭窄层
219	Electromagnetic Stirring	电磁搅拌
220	3 Phases Induction Motor	三相感应电机
221	Non-Contact Type Stirrer	非接触式搅拌器
222	Molten Metal	熔融金属
223	Electromagnetic Action	电磁作用
224	Matrix Alloy	基体合金
225	Wettability	润湿性
226	Reinforced Particles	增强颗粒
227	MMC Fabrication Methods	MMC 制造方法
228	Hybrid Composite Applications	混合复合材料应用
229	Spectrum of Materials	材料谱系
230	Automotive Industry	汽车工业
231	Sustainable Mode of Transportation	可持续交通方式
232	Electric Vehicles (EVs)	电动汽车
233	Lithium-ion Batteries (LIBs)	锂离子电池
234	Vehicle Integration	车辆集成
235	Reuse and Recycling	再利用和回收
236	Anode Materials	正极材料
237	Cathode Materials	负极材料
238	Lithium-Nickel-Cobalt-Aluminium (NCA)	镍钴铝锂
239	Lithium-Nickel-Manganese-Cobalt (NMC)	镍锰钴锂
240	Lithium-Manganese Spinel (LMO)	尖晶石锰锂
241	Lithium Titanate (LTO)	钛酸锂

242	Lithium-ion Phosphate (LFP)	磷酸锂离子
243	Lithium-Cobalt Oxide (LCO)	锂钴氧化物
244	Thermal Runaway	热失控
245	Chemical Reactions	化学反应
246	Heat Release	热量释放
247	Cycle Stability	循环稳定性
248	Overall Age	总使用年限
249	Specific Energy	比能量
250	Specific Power	比功率
251	Trade-off	权衡
252	Charging Time	充电时间
253	Standard 120-volt Outlet	标准 120 伏插座
254	240-volt Outlet	240 伏插座
255	Enhanced Cooling Systems	加强冷却系统
256	Commercial Three-phase Charging Station	商用三相充电站
257	Thermoelectric (TEC)	半导体制冷器（热电制冷器）
258	Jean Peltier	让-珀尔帖
259	Peltier Effect	珀尔帖效应
260	Heat Retention/Discharge	热量保留/释放
261	Conductor Intersection/Junction	导体交点/结点
262	Current Polarity	电流极性
263	Heat Conduction	热传导
264	p-type Semiconductor	p 型半导体
265	n-type Semiconductor	n 型半导体
266	Semiconductor Element	半导体元件
267	Ceramic Plate	陶瓷板
268	Heat Sink	散热器
269	Cold Sink	冷散热器
270	Environment	环境
271	Thermoelectric Module	热电模块
272	Hot Side	热侧

273	Cold Side	冷侧
274	Facilitate	促进
275	Inertial Guidance Systems	惯性制导系统
276	Night Vision Equipment	夜视设备
277	Electronic Equipment	电子设备
278	Infrared Detectors	红外线探测器
279	Integrated Circuit Coolers	集成电路冷却器
280	Laboratory Cold Plates	实验室冷板
281	Cold Chambers	冷室
282	Ice Point Reference Baths	冰点基准浴
283	Dew Point Hygrometers	露点湿度计
284	Hypothermia Blankets	低温毯
285	Blood Analysers	血液分析仪
286	Department of Energy’s National Laboratories	能源部国家实验室
287	Office of Technology Assessment (OTA)	技术评估办公室
288	Mechanical Energy	机械能
289	Rotor of Electrical Motor/Generator	电机/发电机转子
290	Hybrid Energy Storage Mechanism	混合动力储能装置
291	Energy Conversion Efficiency	能量转换效率
292	Rapid Shutdown	迅速停机
293	Maintenance Convenience	维护便利性
294	Material Stability	材料稳定性
295	Manufacturing Process	制造工艺

AppendixII: Source Text and Target Text

Source Text	**Target Text**
Motor Technology – The ‘Centre’ of an Electric Vehicle Efficiency	电机技术 – 电动汽车效率的“核心”
In the energy starving world, demand of energy is continuously raising, of- course not parallel to its supply. This issue become more significant when traditional sources of energy are continuously depleting and people are rushing to resort the renewable energy sources. Electricity is one of the chief renewable energy sources. In the meanwhile, rising prices of the fuel has occurred as an opportunistic symbol for the electric vehicles to come into the picture.	在能源匮乏的世界里，能源供应并不能同时满足能源需求的持续增长。当传统能源不断枯竭，人们急于利用可再生能源时，这对矛盾就尤为突出。电能是主要的可再生能源之一。同时燃料价格的上涨为电动汽车的出现提供了契机。
World is witnessing the regular increase in the demand for electric vehicle since last few decades. So, the demand for new ideas and innovation is also intensifying in this field. Motors are the fundamentals to any vehicle. The basic functioning of the vehicle is largely governed by the power and efficiency of the motor and its supporting technology inside.	过去几十年来，全球对电动汽车的需求持续增长。因此，这一领域对新理念和创新的需求也在不断增加。电机是任何车辆的基础。汽车的基本功能在很大程度上取决于电机及其内部支持技术的功率和效率。

In an electric vehicle, usually direct current (DC) electricity is fed from a battery bank to AC/DC inverter. This inverter converts DC into alternating current(AC) electricity and then it is fed to 3 phase AC induction motor. For small range and slow speed application of electric vehicle, even brushless DC motor is also used. The electrical energy is converted into mechanical energy through motor and fed to wheels through transmission and differential. Normally, it is said that inverter is the brain and motor is heart of the electric vehicle.	在电动汽车中，直流电通常从电池组馈入交直流逆变器。该逆变器将直流电转换为交流电，然后馈送至三相交流感应电机。对于小范围和低速应用的电动汽车，甚至也使用无刷直流电机。电能通过电机转换为机械能，再通过变速器和差速器输送到车轮。通常，逆变器像是电动汽车的大脑，而电机则像是心脏。
In order to understand the potential of the electric motor, the following range of motors can be taken as example:	可以以下一系列例子来了解电机潜力：
15 Kw Traction Motor: It provides almost unlimited maximum speed.	15 千瓦牵引电机： 它的最大速度几乎不受限制。
8 Kw Traction Motor: It is designed for small e-vehicles with speed limit of 45 Km/h.	8 千瓦牵引电机：它专为限速为 45 Km/h 的小型电动汽车设计。正常运行时无需风扇，适用于狭小空间。
4 Kw Traction Motor: It is the ideal motor for light weight e- vehicles for recreational	4 千瓦 牵引电机： 它是轻型电动休闲车、越野车（如高尔夫球车或全地形车）以及空间有限的运输车辆的理想电机。

uses, for off-road vehicles- for example, golf cars or ATVs (All Terrain Vehicles) and alternatively for transport vehicles that have limited space.	
1.5 Kw Traction Motor: Typical uses for this electric motor are for scooter and go-carts.	1.5 千瓦牵引电机：这种电机通常用于踏板车和卡丁车。
The rotor in an induction motor is specially designed with internal magnet that creates almost sine distribution of the magnetic flux. Because no external magnetization is required, there are no losses in the rotor through magnetization currents. The efficiency of electric motor is judged through its function of torque and speed. However, the heating of the motors at high speed is an area which require further innovation and development.	感应电机转子的内部磁体经过特殊设计，可产生近乎正弦的磁通分布。由于不需要外部磁化，因此转子不会因磁化电流而产生损耗。电动机的效率是通过其扭矩和速度功能来判断的。然而，电机在高速运转时的发热问题是一个需要进一步创新和发展的领域。
The manufacturers have started using permanent magnet electric motor instead of the AC induction motor. The advantage is that unlike AC induction motor which uses electricity to generate the magnetic currents inside the motor, which causes rotor to spin, permanent magnet motors does not require that additional current since its magnets which are created from	制造商已开始使用永磁电机代替交流感应电机。其优点在于，交流感应电机使用电力在电机内部产生磁流，从而使转子旋转，而永磁电机则不同，它不需要额外的电流，因为它的磁铁是由稀土材料制成的，始终处于开启状态。但这种电机只适用于较小和较轻的汽车。高性能汽车需要更大的功率，而这只能由感应电机产生。

rare-earth materials are always on. But these motors are suitable only for smaller and lighter cars. The high performance cars require greater power which can only be produced by induction motors.	
Efforts are also on to reduce the cost of electric motors by using different materials that can reduce the losses with improved performance. Another, effort manufacturers have put in to reduce the size of motor is by using square copper wires instead of round ones in its stator. The stator is a stationary part of an electric motor, which generates the alternating magnetic field to spin the rotor. This is because square wires nest more compactly and densely.	此外，制造商们还在努力通过使用不同的材料来降低电动机的成本，从而在提高性能的同时减少损耗。制造商为减小电机尺寸所做的另一项努力是在定子中使用方形铜线而不是圆形铜线。定子是电机的静止部分，它产生交变磁场使转子旋转。这是因为方形导线嵌套得更紧凑、更密集。
The motor designers have also used three smaller magnets in place of two larger ones for the motor which helps to improve torque. Some innovators have even used non-rare- earth materials like Daido Steel to make magnets to reduce their cost. One more example is Neodymium magnet that contains no rare-earth-material but it is still powerful enough for vehicle use. The aim is to develop motors with high RPM of 30,000. At present it ranges from	电机设计师还使用了三块较小的磁铁来代替两块较大的磁铁，这有助于提高扭矩。而一些想法丰富的设计师甚至使用日本大同钢等非稀土材料来制造磁铁，以降低成本。另一个例子是钕磁铁，它不含稀土材料，但仍有足够的功率供汽车使用。目标是开发出每分钟 30,000 转的高转速电机。目前的转速范围为 每分钟 12,000 至 18,000 转。

12,000 to 18,000 RPM.	
There is no exaggeration in making a statement that a lot is required to be done in development of motors with higher efficiency and torque in case we wish to replace gasoline driven vehicles with all electric vehicles.	毫不夸张地说，如果想用全电动汽车取代汽油驱动的汽车，就必须大力开发效率更高、扭矩更大的电机。
Electromagnetic Stir Casting: An Approach to Produce Hybrid Metal Matrix Composite (MMC)	电磁搅拌铸造：生产混合金属基复合材料（MMC）的方法
A metal matrix composite is a composite material that constitutes one metal and other different metal or another material like ceramic or organic compound. When at least three materials are present it constitutes hybrid MMC. The use of composite increases day by day in defense, automobile, aviation, aerospace industry. Now a day's hybrid MMC development and characterization play an important role in the industry. Hybrid aluminium MMC has better mechanical properties like hardness, tensile strength, impact strength,microstructural morphology etc. and good tribological properties.	金属基复合材料是一种由一种金属和其他不同金属或其他材料（如陶瓷或有机化合物）组成的复合材料。当至少有三种材料同时存在时，就构成了混合金属基复合材料。在国防、汽车、航空和航天工业中，复合材料的使用与日俱增。如今，混合 MMC 的开发和表征在工业中发挥着重要作用。 混合铝 MMC 具有更好的机械性能，如硬度、拉伸强度、冲击强度、微观结构形态等，并具有良好的摩擦学性能。
The metal matrix materials for hybrid	混合金属基复合材料的金属基体材料有铝、铜、镁、钛合金等，而增强材料可

MMC are aluminum, copper, magnesium, titanium alloys while the reinforcement can be widely used Al2O3, SiC, BN, B4C, B, AlN, TiB2, graphite etc. Electromagnetic stir casting method is an effective way to produce hybrid metal matrix composites. Electromagnetic fields are often used industrially to control the flow of liquid metal. An alternating field induces eddy currents in liquid metal which interact with the field to give a Lorentz body force which is generally rotational and which must, therefore, drive fluid motion.	广泛使用 Al2O3、SiC、BN、B4C、B、AlN、TiB2、石墨等。电磁搅拌铸造法是生产混合金属基复合材料的一种有效方法。工业上通常使用电磁场来控制液态金属的流动。交变磁场会在液态金属中产生涡流，涡流与磁场相互作用，产生洛伦兹力，洛伦兹力是旋转的，因此必须驱动流体运动。
In the high-frequency limit, the field is confined to a narrow layer on the surface of the conductor. Electromagnetic stirring uses the principle of a 3 phases induction motor and it differs from the conventional mechanical stirrer as it is a non-contact type stirrer in which no part is in contact with the molten metal. The molten metal is mixed with the material by electromagnetic action.	在高频极限下，磁场仅限于导体表面的一个狭窄层。电磁搅拌采用三相感应电机的原理，与传统的机械搅拌器不同，它是一种非接触式搅拌器，没有任何部件与熔融金属接触。 熔融金属在电磁作用下与材料混合。
Electromagnetic stirring has the advantage of having no contact between the melt and the stirring system. To achieve the	电磁搅拌的优点是熔体和搅拌系统之间没有接触。为了使混合型多孔质金属材料达到最佳性能，增强材料在基体合金中的分布应均匀，这些物质之间的润湿性也应达到最佳。由于增强颗粒分布更

optimum properties of the hybrid MMC, the distribution of the reinforcement material in the matrix alloy should be uniform, and the wettability between these substances should be optimum. This method is having an edge over other MMC fabrication methods due to the more uniform distribution of reinforced particles. Hybrid composite applications continue to expand, the spectrum of materials and processes employed will remain relatively wide.	均匀，这种方法比其他 MMC 制造方法更具优势。混合复合材料的应用范围在不断扩大，所采用的材料和工艺也将相对广泛。
Challenges and Opportunities in lithium-ion battery technologies for electric vehicles	电动汽车锂离子电池技术的挑战与机遇
The automotive industry's quest to limit its impact on the environment and transform automotive mobility into a sustainable mode of transportation continues at high intensity, despite the current economic crisis. The major issue which is still haunting the electric vehicles is the technology and cost of lithium-ion batteries. Normally, the value chain of electric vehicle batteries consists of raw material for production, cell production, module production, assembly of modules into the battery pack, integration of the	尽管面临当前的经济危机，但汽车行业仍在持续努力减少对环境的影响，并将汽车交通转变为一种可持续的交通方式。锂离子电池的技术和成本仍是困扰电动汽车的主要问题。通常，电动汽车电池的价值链包括生产原料、电池生产、模块生产、将模块组装成电池组、将电池组集成到汽车中、在汽车寿命期内使用以及再利用和回收。

battery pack into the vehicle, use during the life of the vehicle, and reuse and recycling.	
Lithium-ion batteries comprise a family of battery chemistries that employ various combinations of anode and cathode materials. The most prominent technologies for automotive applications are lithium-nickel-cobalt-aluminium(NCA), Lithium-nickel-manganese-cobalt(NMC), Lithium- manganese spinel(LMO), Lithium titanate(LTO) and Lithium-ion phosphate (LFP). The technology that is currently most prevalent in consumer application is lithium-cobalt oxide(LCO), which is generally considered unsuitable for automotive applications because of its inherent safety risks.	锂离子电池由一系列采用不同正负极材料组合的电池化学成分组成。汽车应用中最主要的技术是镍钴铝锂（NCA）、镍锰钴锂（NMC）、尖晶石锰锂（LMO）、钛酸锂（LTO）和磷酸锂离子（LFP）。目前在消费者应用中最普遍的技术是锂钴氧化物（LCO），由于其固有的安全风险，一般认为不适合汽车应用。
The key performance parameters for electric vehicle batteries are discussed in succeeding paras.	下文将讨论电动汽车电池的关键性能参数。
Safety: It is the most important criterion. The main concern is thermal runaway. In this the chemical reactions triggered in the cell exacerbate heat release, and thus resulting in a fire.	安全： 这是最重要的标准。对安全主要的担忧就是热失控。在这种情况下，电池中引发的化学反应会加剧热量释放，从而导致火灾。
Life Span: Two ways of measuring battery	使用寿命： 衡量电池寿命的两种方法是循环稳定性和整体老化。循环稳定性是

life span are cycle stability and overall age. Cycle stability is the number of times a battery can be fully charged and discharged before being degraded to 80 percent of its original capacity at full charge. Overall age is the number of years a battery can be expected to remain useful.	指电池在充满电和放电后，电量下降到原始电量的 80% 的次数。总使用年限是指电池的预期使用年限。
Specific Energy and Specific Power: The specific energy of batteries is their capacity for storing energy per kilogram of weight. Specific power is the amount of power that batteries can deliver per kilogram of mass. There is a need to optimize the trade-off between specific energy and specific power.	比能量和比功率：电池的比能量是指电池每公斤重量的储能能力。比功率是指电池每公斤质量所能提供的功率。需要优化比能量和比功率之间的权衡。
Charging Time: It almost takes ten hours to charge a 15-Kwh battery by plugging it into a standard 120-volt outlet. 240-volt outlet with increased power (40 amps) can take two hours. Charging at a commercial three-phase charging station can take as little as 20 mins. However, these charging systems do come at an additional cost and weight, as they require enhanced cooling systems in the vehicle.	充电时间：将 15 千瓦时的电池插入标准的 120 伏插座充电，几乎需要 10 个小时。功率更大（40 安培）的 240 伏插座则需要两小时。在商用三相充电站充电只需 20 分钟。不过，这些充电系统需要额外的成本和重量，因为它们需要加强车内的冷却系统。
The challenge and tremendous opportunity still remains with cell manufacturers. As of now chemical companies and	电池制造商面临的挑战和巨大机遇依然存在。目前，化工公司和零部件生产商往往认为电动汽车业务只占其总收入的一小部分。它们最终将为电池制造提供活性材料、隔膜和其他关键部件。电动

component producers tend to see the electric vehicle business as representing only a small percentage of their overall revenues. They will ultimately supply active materials, separators and other key parts for cell manufacturing. The continued growth of the market for electric vehicles will finally depend on new battery technologies, and the will of governments as well as on driving patterns and definitely on price of gasoline.	汽车市场的持续增长最终将取决于新电池技术、政府意愿、驾驶模式以及汽油价格。
90 Degree Steering Mechanism	90 度转向装置
Let’s know more and get inspired	深入了解一下
It’s Working Principle	工作原理
This project works on the principle that the two alternate diagonal wheels i.e. the front left and back right will steer together to give the turning motion to the vehicle and similarly with the other two wheels through chain drive arrangements. In this vehicle all the four wheels will be independently working & the battery provided which is connected to the control unit will provide the necessary power supply.	这个项目的工作原理是，两个交替的对角线车轮（即前左轮和后右轮）将一起转向，使车辆产生转弯运动，同时另外两个车轮也将通过链传动装置产生转弯运动。在这辆车上，所有四个车轮都将独立工作，与控制单元连接的电池将提供必要的电力供应。
Objective for the study	研究目的

To obtain a large steering angle. To enable small sharp turns to be made smoothly without wheel lock-up occurring even at large steering angles. To make it possible to change the driving rotation direction and the amount of rotation of front and rear wheels and inner and outer wheels in dependence upon the steering angle.	获得较大的转向角。 即使在转向角度较大的情况下，也能平稳地进行小急转弯，而不会出现车轮抱死的情况。 可根据转向角改变驱动旋转方向以及前后轮和内外轮的旋转量。
What benefits can be driven out of this?	研究的意义
With the 360 mode, the vehicle can quickly turn around at the press of a button and a blip of the throttle. · Crab mode helps simplify the lane changing procedure. · Due to the better handling and easier 90 degree steering capability, driver fatigue can be reduced even over long drives.	- 利用 360 模式，只需按下按钮和轻点油门，车辆就能快速掉头。 - 螃蟹模式有助于简化变道程序。 -由于更好的操控性和更轻松的 90 度转向能力，即使长途驾驶也能减轻驾驶员的疲劳。
Military reconnaissance and combat vehicles can benefit to a great extent from 360 modes, since the 90 degree steering can be purpose built for their application and are of immense help in navigating difficult terrain.	- 军用侦察车和战车可以在很大程度上受益于 360 模式，因为 90 度转向可以专门为它们的应用而设计，对在困难地形中航行大有帮助。
Where to Apply it Practically-	应用场景
High speed lane changing · High speed straight line operation	-高速变道 -高速直行 -曲线转弯

· Turning on curve · For parking · Junction intersection · Parallel Parking · Gentle curves	-用于停车 -交叉路口 -并排停车 -缓弯转向
Thermoelectric Cooler : A new horizon in Mechanical and Electronics Engineering	半导体制冷器：机械与电子工程的新视野
The Thermoelectric (TEC) innovation was first found by a French physicist named Jean Peltier that is why it is also known as a pettier cooler. The main principle behind Peltier effect is that when current is allowed to pass through the circuit of various conductors, heat is either retained or discharged at the conductor's intersections or junctions depend upon their extremity like current polarity. The measure of heat conduction generated or absorbed is corresponding to inter pass with different conductors.	半导体制冷器也叫热电制冷器（TEC），是由一位名叫让-珀尔帖（Jean Peltier）的法国物理学家发明的，因此它也被称为珀尔帖冷却器。珀尔帖效应的主要原理是，当电流通过不同导体的电路时，导体的交点或结点会根据电流极性等极端情况保留或释放热量。产生或吸收热量的量度与不同导体的交叉点相对应。
The Peltier cooler unit is integrated with the set of thermocouple consisting p- and n-type semiconductor elements, or pellets, sandwiched between two ceramic plates. Pairs are combined into a module. It is connected electrically in series so that equi-distribution of current will take place	珀尔帖冷却器装置集成了一套热电偶，由夹在两块陶瓷板之间的 p 型和 n 型半导体元件或颗粒组成。成对的热电偶组合成一个模块。模块采用串联方式进行电气连接，以实现电流的均衡分配；采用并联方式进行热连接，以确保热传导的正常进行。散热器是一种连接到热电模块热侧的装置。它用于促进热量从模块的热侧传递到环境中。冷散热器连接到模块的冷侧，以促进热量传递。

and thermally in parallel so that heat conduction is properly maintained. A heat sink is a device that is attached to the hot side of the thermoelectric module. It is used to facilitate the transfer of heat from the hot side of the module to the environment. A cold sink is attached to the cold side of the module which facilitates heat transfer.	
In general, when a DC voltage is applied across the device, one face cools while the other face heats up. The module itself is made up of p-type and n- type semiconductors connected electrically in series and thermally in parallel. The p-type element has a deficiency of electrons compared to its n-type counterpart, which has a surplus of electrons. In order to complete the lattice of material, the electrons flow from the n-type to the p-type material and holes from p-type to n-type maintained in a material through an electrical connector, dropping to a lower energy state and releasing energy heat to the heat sink (hot side).	一般来说，当在器件上施加直流电压时，一个面会冷却，而另一个面会升温。模块本身由电串联和热并联的 p 型和 n 型半导体组成。与电子过剩的 n 型元件相比，p 型元件缺少电子。为了完善材料晶格，电子从 n 型流向 p 型材料，空穴从 p 型流向 n 型，通过电连接器保持在材料中，下降到较低的能量状态，并向散热器（热侧）释放能量热量。
Thermoelectric cooler can be of two types:-	热电冷却器可分为两种类型：

1. Single stage Thermoelectric cooler 2. Multi-stage Thermoelectric cooler	1. 单级半导体冷却器 2. 多级半导体冷却器
Single stage thermoelectric coolers work at the permissible range at the temperature difference of 74-76 degrees Kelvin. In order to create a great difference in the temperature range, many research is going on multi-stage thermoelectric coolers are used. For example, the maximum temperate difference of one of the serial thermoelectric coolers is 140 degrees, Kelvin.	单级半导体冷却器的工作温度允许范围为 74-76 开尔文温差。为了使温差范围更大，许多研究都在使用多级半导体冷却器。例如，一种串联式半导体冷却器的最大温差为 140 开尔文。
Advantage:	半导体制冷器的优势
1. No release of harmful substances which can affect the environment. 2. The thermoelectric cooler doesn't require any fluid, gases for cooling. 3. It doesn't emit any noise. 4. Lesser size and weight of thermoelectric cooler are reduced. 5. A thermoelectric cooler is reliable. 6. Its cooling and heating capacity can be adjustable.	1. 不释放会影响环境的有害物质。 2. 热电冷却器不需要水冷或者气冷。 3. 不会发出任何噪音。 4. 减少了半导体制冷片的体积和重量。 5. 半导体制冷片性能可靠。 6. 冷却和加热能力可调。
Application:	应用场景
1. Military/Aerospace: Inertial guidance	1. 军事/航空航天： 惯性制导系统、夜视设备、电子设备、冷却个人服装、

systems, night vision equipment, electronic equipment, cooled personal garments, portable refrigerators. 2. Consumer products: Recreational vehicle refrigerators, mobile home refrigerators, portable picnic coolers, wine and beer keg coolers, residential water coolers/ purifiers. 3. Laboratory and scientific equipment: Infrared detectors, integrated circuit coolers, laboratory cold plates, cold chambers, ice point reference baths, dew point hygrometers. 4. Industrial Equipment: Computer microprocessors, microprocessors in numerical control and robotics, medical instruments, hypothermia blankets, pharmaceutical refrigerators- portable and stationary, blood analysers, tissue preparation and storage, restaurants equipment, cream and butter dispensers. Miscellaneous: Hotel room refrigerators, automobile mini – refrigerators, automobile seal cooler, aircraft drinking water coolers.	便携式冰箱。 消费品： 休闲车冰箱、活动房屋冰箱、便携式野餐冷却器、葡萄酒和啤酒桶冷却器、住宅水冷却器/净化器。 3. 实验室和科学设备：红外线探测器、集成电路冷却器、实验室冷板、冷室、冰点基准浴、露点湿度计。 4. 工业设备：计算机微处理器、数控和机器人微处理器、医疗仪器、低温毯、便携式和固定式制药冰箱、血液分析仪、组织制备和储存、餐饮设备、奶油和黄油分配器。 5. 杂项：酒店房间冰箱、汽车迷你冰箱、汽车密封冷却器、飞机饮用水冷却器。
Performance And Cost Of Other Types Of Light-Duty Vehicles	其他类型轻型汽车的性能和成本

Most of the results of OTA's analyses of mid-size autos apply similarly, on a percentage basis, to other auto size classes—such as subcompacts—and to light trucks. There are, however, some interesting differences. For example, the aerodynamics of different vehicle classes are subject to different constraints. Subcompacts are unlikely to attain as low a drag coefficient as mid-size vehicles because their short lengths inhibit optimum shapes for minimum drag. Pickup trucks, with their open rectangular bed and higher ride height have relatively poor drag coefficients, and fourwheel-drive pickups are even worse, because of their large tires and higher ground clearance. And compact vans and utility vehicles have short noses, relatively high ground clearance, and box-type designs that restrict drag coefficients to relatively high values. Although each vehicle type can be made more aerodynamic, it is unlikely that light-truck drag values will decline quite so much as automobile drag values can.	按百分比计算，OTA 对中型汽车的大部分分析结果同样适用于其他尺寸级别的汽车（如超小型汽车）和轻型卡车。不过，也存在一些有趣的差异。例如，不同级别汽车的空气动力学受到不同的限制。超小型汽车不可能达到中型汽车那样低的风阻系数，因为它们的车身长度较短，无法达到最小风阻的最佳形状。皮卡车具有开放式矩形车床和较高的车身高度，风阻系数相对较低，而四轮驱动皮卡车由于轮胎较大、离地间隙较高，风阻系数甚至更低。而紧凑型厢式货车和多用途车的车头较短，离地间隙相对较高，箱式设计将风阻系数限制在相对较高的数值。虽然每种车型都可以改进空气动力学性能，但轻型卡车的阻力值不可能像汽车的阻力值那样大幅下降。
Another important difference is	另一个重要区别是基于市场--从历史上看，轻型卡车新技术的引进通常比汽车

market-based—historically, introduction of new technologies on light-duty trucks has typically lagged by five to seven years behind their introduction in cars. Although this lag time might change, it is likely that some lag will continue to persist.	新技术的引进滞后五到七年。尽管这一滞后时间可能会有所改变，但某些滞后现象很可能会继续存在。
Differences in the functions of the different vehicle classes will affect fuel economy potential, as well. For example, the load-carrying function of many light trucks demands high torque at low speed, and may demand trailer- towing capability. The latter requirement, in particular, will constrain the type of performance tradeoffs that might be very attractive for passenger cars using electric or hybrid-electric powertrains.	不同级别车辆的功能差异也会影响燃油经济性。例如，许多轻型卡车的载重功能需要在低速时具有高扭矩，并可能需要具有拖车牵引能力。特别是后种需求，将很可能导致限制使用电动或混合电动动力系统的乘用车在性能上进行限制。
Whereas OTA expects the business-as-usual fleet of automobiles to improve in fuel economy by about 24 percent between 1995 and 2015, the fuel economy of the light truck fleet is expected to increase a bit less than 20 percent. Prices will scale with size: for example, for hybrids, subcompact prices will increase by about 80 percent of the mid-size car’s price increment, compact	OTA 预计，从 1995 年到 2015 年，正常行驶的汽车的燃油经济性将提高约 24%，而轻型卡车的燃油经济性预计将提高不到 20%。价格将随车型大小而变化：例如，对于混合动力汽车而言，超小型汽车的价格增幅将是中型汽车价格增幅的 80%，小型货车的增幅约为 110%，而标准皮卡的增幅约为 140%，这反映了不同级别汽车对动力的不同要求。

vans by about 110 percent, and standard pickups by about 140 percent, reflecting the different power requirements of the various vehicle classes.	
Lifecycle Cost---Will They Offset Higher Purchase Prices?	生命周期成本能否抵消较高的购买价格？
Although vehicle purchasers may tend to focus on initial purchase price more than on operating and maintenance (O&M) costs and expected vehicle longevity in their purchase decisions, large reductions in O&M costs and longer lifespans may offset purchase price advantages in vehicle purchase decisions. For example, diesel-powered vehicles typically cost more than the same model with a gasoline engine, and often are less powerful, but are purchased by shoppers who respect their reputation for longevity, low maintenance, and better fuel economy, or who are swayed by diesel fuel's price advantage (in most European nations), or both. Proponents of advanced vehicle technologies, especially EVs and fuel cell EVs, often cite their claimed sharp advantages in fuel costs, powertrain longevity, and maintenance costs as	尽管购车者在做出购车决定时，往往更关注初始购买价格，而不是运营和维护（O&M）成本以及车辆的预期使用寿命，但运营和维护成本的大幅降低以及使用寿命的延长可能会抵消购车决定中的购买价格优势。例如，柴油动力汽车的价格通常高于汽油发动机的同类车型，而且动力通常也较弱，但购买者却因为柴油动力汽车具有使用寿命长、维护成本低和燃油经济性好的特点，或者因为柴油燃料的价格优势（在大多数欧洲国家），或者两者兼而有之而购买柴油动力汽车。先进汽车技术（尤其是电动汽车和燃料电池电动汽车）的支持者通常会将其在燃料成本、动力总成寿命和维护成本方面的显著优势作为购买它们的充分经济理由，而不仅仅是社会优势。

sufficient economic reasons to purchase them—aside from their societal advantages.	
A few simple calculations show how a substantially higher vehicle purchase price may indeed be offset by lower O&M costs or longer vehicle lifetime. Assuming a 10 percent interest rate and 10-year vehicle lifetime, for example, a $1,000 increase in purchase price would be offset by a $169 per year reduction in O&M costs. Since average annual maintenance costs for gasoline vehicles are $100 for scheduled maintenance and $400 for unscheduled maintenance over the first 10 years of vehicle life,55 there is potentially a substantial purchase price offset if advanced vehicles can achieve very low maintenance costs. Similarly, an increase in vehicle price of about 25 percent—for example, from $20,000 to $25,000-would be offset by an increase in longevity of 5 years, assuming the less expensive vehicle would last 10 years.	一些简单的计算表明，车辆购买价格的大幅提高可能确实会被较低的运行和维护成本或较长的车辆使用寿命所抵消。例如，假设利率为 10%，车辆使用寿命为 10 年，那么购买价格上涨的 1000 美元将被每年减少的 169 美元运行和维护费用所抵消。由于在车辆寿命的前 10 年中，汽油车的年均定期维护成本为 100 美元，不定期维护成本为 400 美元，55 因此，如果先进车辆的维护成本非常低，就有可能抵消大量的购买价格。同样，假设价格较低的车辆可使用 10 年，那么车辆价格上涨约 25%--例如从 20,000 美元上涨到 25,000 美元--将被寿命延长 5 年所抵消。
OTA’s evaluation of lifecycle costs leads to the conclusion that their influence will	OTA 对生命周期成本的评估得出的结论是，只有在有限的条件下，生命周期成本的影响才能抵消大幅提高的购买价

offset sharply higher purchase prices only under limited conditions. For example, unless gasoline prices increase substantially over time, any energy savings associated with lower fuel use or a shift to electricity will provide only a moderate offset against high purchase price- primarily because annual fuel costs are not high in efficient conventional vehicles.	格。例如，除非汽油价格随着时间的推移而大幅上涨，否则任何与降低燃料使用量或转用电力相关的节能措施都只能适度抵消高昂的购买价格--这主要是因为高效传统汽车的年燃料成本并不高。
In the mid-size vehicles OTA examined for 2015, for $1.50 a gallon gasoline, the minimum savings (NiMH EV versus baseline vehicle, savings of about $400 per year—see table 1-3) would offset about $2,300 in higher purchase price for the NiMH EV. In contrast, the EV may cost as much as $10,000 more than the baseline vehicle. Moreover, percent of the fuel cost savings could be obtained by purchasing the mpg advanced conventional vehicle, which costs only $1,500 more than the baseline vehicle.	在 OTA 2015 年考察的中型车中，如果每加仑汽油的价格为 1.50 美元，最低可节省的费用（镍氢电动汽车与基准车辆相比，每年可节省约 400 美元--见表 1-3）将抵消镍氢电动汽车较高的购买价格约 2300 美元。相比之下，电动汽车的价格可能比基准车辆高出 10,000 美元。此外，购买高级传统汽车可节省燃油成本的百分比，该汽车的价格比基准汽车仅高出 1,500 美元。
Experts contacted by OTA generally agree that electric drivetrains should experience lower maintenance costs and last longer	OTA 的专家普遍认为，与内燃机驱动系统相比，电力驱动系统的维护成本更低，使用寿命更长。然而，由于内燃机驱动系统的不断改进（例如，推出了在 100,000 英里内无需调整的发动机），

than ICE drivetrains. The amount of savings is difficult to gauge, however, and may not be large because of continuing improvements in ICE drivetrains (for example, the introduction of engines that do not require a tune-up for 100,000 miles) and the likelihood that future electric drivetrains will undergo profound changes from today's, with unknown consequences for their longevity and maintenance requirements. Moreover, battery replacement costs for EVs (and hybrids and fuel cell EVs to a lesser extent) could offset other savings, although this, too, is uncertain because it is not yet clear whether battery development will succeed in extending battery lifetime to the life of the vehicle. Vehicles with hybrid drivetrains may experience no O&M savings because of their complexity. Finally, although analysts have claimed that fuel cell vehicles will be low maintenance and long-lived, the very early development state of PEM cells demands caution in such assessments, and we see little basis for them. In particular, fuel cells have a complex balance of plant, a methanol	以及未来的电动驱动系统很可能会发生与现在不同的深刻变化，从而对其寿命和维护要求产生未知的影响，因此节省的费用很难估算，而且可能不会很多。此外，电动汽车（混合动力汽车和燃料电池电动汽车在较小程度上）的电池更换费用可能会抵消其他节省的费用，尽管这也是不确定的，因为目前还不清楚电池开发是否能成功地将电池寿命延长至汽车的使用寿命。采用混合动力传动系统的汽车由于其复杂性，可能不会节省运行和维护费用。最后，虽然有分析家声称燃料电池汽车维护成本低、使用寿命长，但由于 PEM 电池的开发尚处于早期阶段，因此这种评估必须谨慎，我们认为这种评估缺乏依据。特别是，燃料电池有一个复杂的设备平衡，一个需要进行气体净化以避免燃料电池催化剂中毒的甲醇转化器，以及一些仍未解决的与运行和维护相关的问题，如阴极氧化和薄膜老化。

reformer with required gas clean-up to avoid poisoning the fuel cell's catalysts, and a number of still-unresolved O&M-related issues such as cathode oxidation and deterioration of membranes.	
Emissions Performance	排放性能
Reductions in vehicular emissions are a key goal of programs to develop advanced technology vehicles. In California, it is the only explicit goal, although other considerations, such as economic development, are important. Furthermore, PNGV's original name was the Clean Car Initiative.	减少汽车尾气排放是先进技术汽车发展计划的一个关键目标。在加州，这是唯一明确的目标，尽管经济发展等其他考虑因素也很重要。此外，PNGV 最初的名称是〞清洁汽车计划〞。
The drive to ratchet down the emissions of new vehicles is highly controversial. One reason is that most vehicular emissions come from older vehicles, or relatively new vehicles whose emission controls are malfunctioning. Automakers have long argued that new control requirements that raise the price of new vehicles have the effect of slowing new vehicle sales and, thus, reducing fleet turnover-the primary source of improved fleet emissions (and fuel economy) performance. Further, there is substantial disagreement about how	降低新车排放的政策备受争议原因之一便是，大多数排放来自老车或排放控制失灵的新车。汽车制造商长期以来一直认为，提高新车价格的新控制要求会导致销售放缓，从而降低更替率--车队排放（和燃油经济性）性能改善的主要来源。此外，人们对新控制措施的成本存在很大分歧，对其成本与收益的平衡也存在类似分歧。

much new controls will cost, and thus similar disagreement about their balance of costs and benefits.	
Each of the advanced vehicles examined by OTA have emission characteristics that are different from current vehicles as well as from the baseline (business-as-usual) vehicles expected to enter the fleet, if there are no new incentives for significant changes in vehicle technology. A number of changes that will yield improvements to new vehicles' emission performance, however, already are programmed into vehicle development programs. Both the federal Clean Air Act and California's Low Emission Vehicle Program require significant improvements in the certified emission levels allowable for new light-duty vehicles, as well as an extension of the certified "lifetime" of required control levels from 50 thousand to 100 thousand miles. New requirements for onboard diagnostics to alert drivers and mechanics to problems with control systems, more stringent and comprehensive inspection and maintenance testing (including testing for	如果没有新的激励措施来促进车辆技术的重大变革，那么 OTA 研究的先进车辆的排放特性都不同于当前的车辆，也不同于预计将进入市场的（正常出售）车辆。然而，车辆开发计划已纳入了一些能改善新车排放性能的变化。联邦《清洁空气法案》和加州的低排放汽车计划都要求大幅提高新轻型汽车的认证排放水平，并将所需控制水平的认证 "寿命"从 5 万英里延长到 10 万英里。对车载诊断系统的新要求可提醒驾驶员和机械师注意控制系统的问题，更严格、更全面的检查和维护测试（包括蒸发排放测试），以及认证测试程序的扩展，以包括当今导致高排放水平的驾驶条件，这些都应确保普通车辆的实际道路排放更接近新车认证排放水平。

evaporative emissions), and expansion of certification testing procedures to include driving conditions that today cause high emission levels should ensure that actual on-road emissions of average vehicles more closely match the new vehicle certification emissions levels.	
The Advanced Conventional vehicles will most closely resemble the baseline vehicles’ emissions performance. By 2015, however, these vehicles will have direct injection engines-either diesel or gasoline. These engines should have lower cold start and acceleration enrichment-related emissions than conventional gasoline engines. This should have a positive impact on emissions, although new regulations should force down such emissions even in the baseline case. A key uncertainty about emissions performance for these vehicles is the performance of the NOX catalysts, which currently remain under development. Another area of concern, for the diesels, is particulate emissions performance; although new diesel designs have substantially reduced particulate emissions, these emissions levels are still	先进常规车辆的排放性能与基准车辆最为接近。不过，到 2015 年，这些车辆将采用柴油或汽油直喷发动机。与传统汽油发动机相比，这些发动机的冷启动和加速增压相关排放应该更低。这应该会对排放产生积极影响，尽管即使在基准情况下，新法规也会强制降低此类排放。这些车辆排放性能的一个关键不确定因素是氮氧化物催化剂的性能，该催化剂目前仍在开发中。对于柴油车来说，另一个令人担忧的方面是微粒排放性能；尽管新的柴油车设计已大大减少了微粒排放，但这些排放水平仍大大高于汽油车。

considerably higher than those of gasoline vehicles.	
The key emissions advantage of EVs is that they have virtually no vehicular emissions regardless of vehicle condition or age-they will never create the problems of older or malfunctioning “super-emitters,” now a significant concern of the current fleet. Because EVs are recharged with powerplant- generated electricity, however, EV emissions performance should be viewed from the standpoint of the entire fuel cycle, not just the vehicle. From this standpoint, EVs have a strong advantage over conventional vehicles in emissions of HC and CO, because power generation produces little of these pollutants. Where power generation is largely coal-based—as it is in most areas of the country-some net increases in sulphur dioxide might occur. However, Clean Air Act rules “cap” national powerplant emissions of sulphur oxides (SOX) at about 9 million tons per year, which limits the potential adverse effects of any large-scale increase in power generation associated with EVs Any net advantage (or disadvantage) in	电动汽车的主要排放优势在于，无论车辆状况或车龄如何，它们几乎没有车辆排放物--它们永远不会产生老旧或故障的〞超级排放器〞问题，而这正是当前车辆的一个重要问题。然而，由于电动汽车使用发电厂产生的电力充电，因此电动汽车的排放性能应从整个燃料循环的角度来看待，而不仅仅是车辆。从这个角度来看，电动汽车在 HC 和 CO 排放方面比传统汽车更有优势，因为发电几乎不会产生这些污染物。在发电主要以煤炭为主的地方--如美国大部分地区--可能会出现二氧化硫的净增长。然而，《清洁空气法案》规定，全国发电厂的硫氧化物（SOX）排放量〞上限〞为每年约 900 万吨，这就限制了电动汽车发电量大规模增加的潜在不利影响。所有以化石和生物质为燃料的发电设施都会排放大量的氮氧化物（NOX），大多数发电设施也会排放大量的颗粒物，但由于燃料发电技术和排放控制的不同而存在很大差异。电动汽车对氮氧化物和颗粒物排放影响的分析，对使用哪种发电厂为汽车充电的不同假设、电动汽车和竞争汽油车的能源效率以及汽油车可能的道路排放极为敏感。OTA 估计，2005 年的铅酸电动汽车很可能会在全国范围内增加氮氧化物的净排放量，而镍氢电池驱动的汽车大约会实现收支平衡，但加强对动力装置的氮氧化物控制、继续转向更清洁的发电来源以及提高电动汽车效率的综合影响，将使效率更高的电动汽车在 2015 年获得氮氧化物排放量的小幅净减少。

NOX and particulate emissions of EVs over conventional vehicles is ambiguous, however. All fossil and biomass-fuelled power generation facilities are significant emitters of NOX , and most are significant emitters of particulate, although there are wide variations depending on fuel generation technology, and emission controls. Analyses of the impact of EVs on NOX and particulate emissions are extremely sensitive to different assumptions about which powerplants will be used to recharge the vehicles, as well as assumptions about the energy efficiency of the EVs and competing gasoline vehicles and the likely on-road emissions of the gasoline vehicles. OTA estimates that the year 2005 lead acid EVs will most likely increase net NOX on a nationwide basis, with the NiMH batterypowered vehicle about breaking even, but that the combined effect of increased NOX controls on powerplants, a continuing shift to cleaner generating sources, and increases in EV efficiency will allow the more efficient EVs in 2015 to gain a small net reduction in NOX emissions.	

Hybrid vehicles have been generally considered as likely to have significantly lower emissions than conventional vehicles because of their smaller engines and the supposition that these engines would be run at constant speed and load (for series hybrids). There have been various reports of hybrids attaining very low emissions—below ultralow emissions vehicle standards-in certification-type testing.	人们普遍认为，混合动力汽车的排放量可能大大低于传统汽车，因为混合动力汽车的发动机较小，而且假设这些发动机将以恒定的速度和负荷运行（对于串联式混合动力汽车而言）。有各种报道称，混合动力汽车在认证类测试中达到了非常低的排放--低于超低排放汽车标准。
One key advantage for some hybrids will be their ability to run in an EV- mode in cities, although their performance or range may be limited in this mode. Other advantages are less certain, however. Hybrids will likely not run at constant speed, although their speed and load excursions will be less than with a conventional vehicle; they must cope with cold start and evaporative emissions essentially similar to a conventional vehicle; and their engines may be stopped and restarted several times during longer trips, raising concerns about increased emissions from hot restarts. In OTA's view, hybrid vehicles with substantial EV range have clear emission advantages in	混合动力汽车的优势之一是能够在城市中以电动模式行驶，尽管在这种模式下性能或续航里程可能会受到限制。不过，其他优势就不那么确定了。混动车可能不会以恒定的速度行驶，尽管其速度和负载偏移将小于传统汽车；它们必须应对与传统汽车基本类似的冷启动和蒸发排放问题；在较长的行程中，它们的发动机可能会多次停止和重新启动，这引起了人们对热启动导致排放增加的担忧。OTA 认为，电动汽车续驶里程大的混合动力汽车在这种模式下具有明显的排放优势，但在正常行驶中的优势并不明显。

this mode, but advantages in normal driving are unclear.	
Fuel cell vehicles will have zero emissions unless they use an onboard reformer to process methanol or another fuel into hydrogen. Emissions from the reformer should be extremely low in normal steady-state operation, but there may be some concern about emissions during increased loads, or the potential for malfunctions. In particular, the noble metal catalyst needed for the reformer can be poisoned in the same manner as the catalyst on a gasoline vehicle.	除非使用车载重整器将甲醇或其他燃料转化为氢气，否则燃料电池汽车将实现零排放。重整器在正常稳态运行时的排放量应该极低，但人们可能会担心在负荷增加时的排放量，或发生故障的可能性。特别是转化炉所需的贵金属催化剂可能会像汽油车上的催化剂一样使人中毒。
Safety Of Lightweight Vehicles	轻型车辆的安全性
Several of the advanced vehicles examined by OTA will be extremely light. For example, one of the 2015 advanced conventional vehicles weighs less than 2,000 pounds. An examination of the basic physics of vehicle accidents and the large U.S. database on fatal and injury-causing accidents indicates that a substantial “down weighting” of the light-duty fleet will create some significant safety concerns, especially during the transition period when new, lighter vehicles mix with older, heavier	例如，2015 年的一款先进传统车辆重量不到 2,000 磅。对车辆事故的基本物理原理和美国大型致命和致伤事故数据库的研究表明，轻型车辆的大幅"减重"将带来一些重大的安全问题，尤其是在新的、更轻的车辆与旧的、更重的车辆混合的过渡时期。不过，任何不利的安全影响都不可能像 1970 年至 1982 年新车车队的尺寸和重量构成变化所造成的影响那么严重。 美国国家公路交通安全管理局的结论是，这些变化"导致每年（净）死亡人数增加近 2000 人，重伤人数增加 2 万人。"然而，这些不利影响中有许多是因为车辆的尺寸和重量发生了变化，导致挤压空间减少、轨道宽度和轴距减少（增加了车辆侧翻的发生率）等等。在保持车辆尺寸和结构完整性的同时减轻重量，应该可以降低影响。车辆"轻量化"的主要关注点如下：

ones. Any adverse safety impacts, however, are unlikely to be nearly so severe as those that occurred as a result of changes in the size and weight composition of the new car fleet in 1970 to1982.The National Highway Traffic Safety Administration concluded that those changes “resulted in (net) increases of nearly 2,000 fatalities and 20,000 serious injuries per year. ” Many of those adverse impacts occurred because vehicles changed in size as well as weight, however, yielding reduced crush space, reduced track width and wheelbase (which increased the incidence of vehicle rollovers), and so forth. Reducing weight while maintaining vehicle size and structural integrity should have lower impacts. The major areas of concern about vehicle “light weighting” are the following:	
Passengers in lighter vehicles tend to fare much worse than the passengers in heavier ones in collisions between vehicles of unequal weight, because heavy vehicles transfer more momentum to lighter cars than vice-versa. During the long transition period when older, heavier vehicles would	在重量不相等的车辆之间发生碰撞时，轻型车辆的乘客往往比重型车辆的乘客伤势更重，因为重型车辆比轻型车辆传递更多的动量，反之亦然。在漫长的过渡期内，较重的老式车辆将继续留在车队中，轻型车辆的表现可能会很差。此外，如果大量轻型卡车不按比例减轻重量，它们的重量分布可能会变得更广，从而对安全造成不利影响。

remain in the fleet, lightweight vehicles might fare poorly. Moreover, if the large numbers of light trucks in the fleet do not reduce their weight proportionately, the weight distribution of the fleet could become wider, which would cause adverse impacts on safety.	
Vehicle designers must balance the need to protect passengers from deceleration forces (requiring crush zones of lower stiffness), and the need to prevent passenger compartment intrusion (requiring high strength/high stiffness structure surrounding the passengers). Lighter vehicles will have lower crash energy in barrier crashes or crashes into vehicles of similar weight, so they will require a softer front structure than a heavier vehicle to obtain the same degree of crush (and same protection against deceleration forces) in otherwise similar crashes (e.g., barrier crashes at the same velocity). Designing large, lightweight vehicles with soft structures that have acceptable ride and handling characteristics (structural stiffness is desirable for obtaining good ride and handling characteristics) and are	车辆设计人员必须在保护乘客免受减速力（需要刚度较低的挤压区）和防止乘客车厢入侵（需要乘客周围的高强度/高刚度结构）之间取得平衡。较轻的车辆在撞击障碍物或撞击重量相近的车辆时，碰撞能量较低，因此需要比较重的车辆更软的前部结构，才能在其他相似的撞击中(如以相同的速度撞击障碍物）获得相同程度的挤压（和相同的减速力保护）。设计具有软结构的大型轻质车辆，使其具有可接受的行驶和操控特性（结构刚度是获得良好行驶和操控特性的理想条件），并能防止乘客舱侵入，这对车辆设计师来说可能是一个挑战。此外，轻型和重型车辆对刚度的不同需求可能会在多车碰撞中造成兼容性问题。

protective against passenger compartment intrusion may be a challenge to vehicle designers. Additionally, the differential needs for stiffness among lighter and heavier vehicles may cause compatibility problems in multi-vehicle crashes.	
In collisions with roadside obstacles, lighter vehicles have less chance than a heavier vehicle of deforming the obstacle or even running through it, both of which would decrease deceleration forces on the occupants. Also, a substantial decrease in average vehicle weight might cause compatibility problems with current designs of safety barriers and breakaway roadside devices (e.g., light poles), which are designed for a heavier fleet.	在与路边障碍物发生碰撞时，较轻的车辆比较重的车辆更不容易使障碍物变形，甚至撞穿障碍物，而这两种情况都会减少乘员的减速力。此外，车辆平均重量的大幅降低可能会导致与目前为较重车辆设计的安全路障和路边防撞装置（如灯杆）的兼容性问题。
If weight reductions are achieved by shifting to new materials, vehicle designers may need considerable time to regain the level of modelling expertise currently available in designing steel vehicles for maximum safety.	如果通过改用新材料来减轻重量，汽车设计师可能需要相当长的时间来恢复目前在设计钢制汽车以实现最大安全性方面的建模专业水平。
There exist several safety design improvements that could mitigate any adverse effects caused by large fleetwide weight reductions—though, of course, such measures could improve fleet safety	有几种安全设计改进措施可以减轻大规模减重所造成的任何不利影响--当然，这些措施可以改善任何重量车型的安全。例如，通过雷达感知即将发生的事故来部署外部安全气囊；自动制动等事故规避技术；以及车辆约束系统的改进（包括更灵敏的传感器和可根据事故情况和乘员特征进行调整的〞智能〞安全

at any weight. Examples include external air bags deployed by radar sensing of impending accidents; accident avoidance technology such as automatic braking; and improvements in vehicle restraint systems (including faster acting sensors and “smart” airbags that can adjust to accident conditions and occupant characteristics). The latter would greatly benefit from further biomechanical research to improve our understanding of accident injury mechanisms.	气囊）。受益于进一步的生物力学研究，后者将大大提高我们对事故伤害机制的认识。
Large fleet weight reductions also will intensify the need for the National Highway Traffic Safety Administration to examine carefully its array of crash tests for vehicles, to ensure that these tests provide incentives to maximize vehicle-to-vehicle compatibility in crashes.	大规模的减重还将使美国国家公路交通安全管理局更有必要仔细审查其一系列的车辆碰撞测试，以确保这些测试提供激励措施，在碰撞中最大限度地提高车辆间的兼容性。
A Note About Costs And Prices	关于成本和价格的说明
The price of advanced technologies is a controversial aspect of the continuing debate over the merits of several government actions promoting such technologies. These actions range from the alternative fuel vehicle requirements of the federal Energy Policy Act of 199269	政府推广的先进技术引起了人们的争议，争议的焦点在于价格。这些行动包括 1992 年联邦《能源政策法案》的替代燃料汽车要求、加利福尼亚州的 ZEV 要求以及联邦对 PNGV 的资助（与行业合作）。OTA 对先进传统汽车零售价格差异的估算略低于行业估算，而对混合动力、燃料电池和电动汽车的估算似乎高于其他一些倡导团体的估算。OTA 的估计值与其他估计值之间的部分差异无疑反映了预测新技术未来价格的巨大

to California's ZEV requirements to federal funding (in concert with industry) of PNGV. OTA's estimates of retail price differentials for advanced conventional vehicles are somewhat below industry estimates, while estimates for hybrid, fuel cell, and electric vehicles seem to be above some others prepared by advocacy groups. Part of the difference between OTA's estimates and others undoubtedly reflects the substantial uncertainty that underlies any efforts to predict future prices of new technologies. Other differences arise from the following sources	不确定性。其他差异来自以下方面：
OTA's relatively low incremental prices for advanced conventional vehicles rest partly on our assumption that the advanced technologies are competing with baseline technologies that are new models with newly designed assembly lines; the baseline vehicles are not simply continued production of an existing technology whose investment costs may have been fully amortized.	– OTA 认为先进传统汽车的增量价格相对较低，部分原因在于假定先进技术是与基线技术竞争，而基线技术是具有新设计装配线的新车型；基线汽车不仅仅是现有技术的继续生产，其投资成本可能已经完全摊销。
OTA's relatively high prices for hybrid, fuel cell, and electric vehicles reflect in part OTA's assumption that these vehicles	– OTA 对混合动力车、燃料电池车和电动车的估价相对较高，这部分反映了 OTA 认为这些车辆在性能上与传统车辆具有竞争力；其他估价通常反映了性能较差的车辆，而我们的分析认为这些

are competitive in performance with the baseline, conventional vehicles; other estimates often reflect lesser performing vehicles, which our analysis concludes would be considerably less expensive.	车辆的价格会低很多。
Another source of price differences is OTA's assumption that vehicle prices must costs and manufacturer/dealer profits beyond the manufacturing costs for vehicle price estimates do not reflect these additional costs.	- 造成价格差异的另一个原因是，OTA 假定车辆价格必须包括制造成本以外的成本和制造商/经销商利润，而车辆价格估算并不反映这些额外成本。
Spark Ignition and Diesel Engines	火花点火装置和柴油发动机
Spark Ignition Engines	火花点火发动机
Although spark ignition (SI) engines have been the dominant passenger car and light truck powerplant in the United States for many decades, there are several ways to achieve additional improvements in efficiency---either through wider use of some existing technologies or by introduction of advanced technologies and engine concepts. Some key examples of improved technology, most having some current application, are:	尽管火花点火（SI）发动机几十年来一直是美国乘用车和轻型卡车的主要动力装置，但仍有几种方法可以实现效率的进一步提高--或者通过更广泛地使用某些现有技术，或者通过引入先进技术和发动机概念。以下是一些改进技术的主要例子，其中大多数在当前都有一定的应用：

· Advanced electronic controls; improved understanding of combustion processes. Improved thermodynamic efficiency through improved spark timing, increased compression ratios, and faster combustion. · Use of lightweight materials in valves, valve springs, and pistons, advanced coatings on pistons and ring surfaces, improved lubricants. Reduced mechanical friction. · Increased number of valves per cylinder (up to five), variable timing for valve opening, deactivating cylinders at light loads, variable tuning of intakes to increase intake pressure. Reduce “pumping losses” caused by throttling the flow of intake air to reduce power output.	- 先进的电子控制；提高对燃烧过程的了解。通过改进火花正时、提高压缩比和加速燃烧，提高热力学效率。 - 在气门、气门弹簧和活塞中使用轻质材料，在活塞和活塞环表面使用高级涂层，改进润滑剂。减少机械摩擦。 -增加每个气缸的气门数量（最多五个）、可变气门开启时间、轻载时停用气缸、可变进气调整以增加进气压力。减少因节流进气流而造成的 "泵送损失"，从而降低功率输出。
Combining the full range of improvements in a conventional engine can yield fuel economy improvements of up to 15 percent from a baseline four-valve engine.	与四气门发动机相比，在传统发动机中结合使用各种改进措施可使燃油经济性提高 15%。
Besides improvements in engine components, new engine concepts promise additional benefits. The highest level of technology refinement for SI engines is the direct injection stratified charge	除了发动机部件的改进，新的发动机概念还带来了更多好处。SI 发动机的最高技术改进水平是分层直接喷射（DISC）发动机。DISC 发动机将燃料直接喷入气缸，而不是像传统发动机那样将燃料和空气预混合；"分层加注 "的出现是因为需要将喷射的燃料对准火花塞，因此气缸中的燃料-空气混合物非常不均匀。

(DISC) engine. DISC engines inject fuel directly into the cylinder rather than premixing fuel and air, as conventional engines do; the term “stratified charge” comes from the need to aim the injected fuel at the spark plug, so the fuel-air mixture in the cylinder is highly nonuniform. DISC engines are almost unthrottled; power is reduced by reducing the amount of fuel injected, not the amount of air. As a result, these engines have virtually no throttling loss and can operate at high compression ratios (because not premixing the fuel and air avoids premature ignition). DISC engines have been researched for decades without successful commercialization, but substantial improvements in fuel injection technology and in the understanding and control of combustion, and a more optimistic outlook for nitrogen oxide (NOX) catalysts that can operate in an oxygen-rich environment make the outlook for such engines promising. The estimated fuel economy benefit of a DISC engine coupled with available friction-reduction technology and variable valve timing ranges from 20 to 33 percent,	DISC 发动机几乎不节流；通过减少喷油量而不是空气量来降低功率。因此，这些发动机几乎没有节流损失，可以在高压缩比下工作（因为不预混合燃料和空气可避免过早点火）。对 DISC 发动机的研究已经进行了数十年，但并未成功实现商业化，不过，燃料喷射技术以及对燃烧的理解和控制都有了实质性的改进，而且可以在富氧环境中工作的氮氧化物（NOX）催化剂的前景也更加乐观，这一切都使得此类发动机的前景充满希望。与基准四气门发动机相比，采用现有减摩技术和可变气门正时技术的 DISC 发动机的燃油经济性估计可提高 20% 至 33%。

compared to a baseline four-valve engine.	
Diesel Engines	柴油机
Automakers can achieve a substantial improvement in fuel economy by shifting to compression ignition (diesel) engines. Diesels are more efficient than gasoline engines for two reasons. First, they use compression ratios of 16:1 to 24:1 versus the gasoline engine's 10:1 or so, which allows a higher thermodynamic efficiency. Second, diesels do not experience the pumping loss characteristic of gasoline engines because they do not throttle their intake air; instead, power is controlled by regulating fuel flow alone. Diesels have much higher internal friction than gasoline engines, however, and they are heavier for the same output.	汽车制造商可以通过改用压燃式（柴油）发动机来大幅提高燃油经济性。柴油发动机比汽油发动机更高效，原因有二。首先，柴油发动机的压缩比为 16:1 至 24:1，而汽油发动机的压缩比仅为 10:1 左右，因此热力学效率更高。其次，柴油发动机不会出现汽油发动机特有的泵送损失，因为柴油发动机不对进气进行节流，而是仅通过调节燃料流量来控制动力。不过，柴油发动机的内部摩擦比汽油发动机大得多，而且在输出功率相同的情况下，柴油发动机也更重。
Diesels are not popular in the U.S. market because they generally have been noisier, more prone to vibration, more polluting, and costlier than comparable gasoline engines. Although they have low hydrocarbon (HC) and carbon monoxide (CO) emissions, they have relatively high NOX and particulate emissions.	柴油发动机在美国市场并不流行，因为与同类汽油发动机相比，它们通常噪音更大、更容易振动、污染更严重、成本更高。虽然它们的碳氢化合物（HC）和一氧化碳（CO）排放量较低，但氮氧化物（NOX）和微粒排放量相对较高。
The latest designs of diesel engines recently unveiled in Europe are far	最近在欧洲发布的最新柴油发动机设计远远优于以前的设计。氧化催化剂和更好的燃料控制大大改善了微粒排放性

superior to previous designs. Oxidation catalysts and better fuel control have substantially improved particulate emission performance. Four-valve per cylinder design and direct injection have separately led to better fuel economy, higher output per unit weight, and lower emissions—though NOX emissions are still too high. Compared with a current gasoline engine, the four valve indirect injection design will yield about a 25 percent mpg gain(about 12 percent gain on a fuel energy basis), while the direct injection (Dl) design may yield as much as a 40 percent gain (30 percent fuel energy gain).	能。每缸四气门设计和直接喷射分别带来了更好的燃油经济性、更高的单位重量输出功率和更低的排放--尽管氮氧化物的排放量仍然过高。与目前的汽油发动机相比，四气门间接喷射设计可提高约 25% 的 MPG（按燃料能量计算可提高约 12%），而直接喷射（DI）设计可提高多达 40%（燃料能量提高 30%）。
The new diesels are likely to meet California's LEV standards for HC, CO, and particulate, but will continue to require a NOX waiver to comply with emission requirements. Although the four-valve design and other innovations (e.g., improved exhaust gas recirculation and improved fuel injection) will improve emissions performance and may allow compliance with federal Tier standards, LEV standards cannot be met without a NOX reduction catalyst. Although	新型柴油机很可能符合加利福尼亚州关于碳氢化合物、一氧化碳和颗粒物的 LEV 标准，但仍需要氮氧化物豁免才能符合排放要求。虽然四气门设计和其他创新（如改进的废气再循环和改进的燃油喷射）将改善排放性能，并可能符合联邦标准，但如果没有氮氧化物减排催化剂，则无法达到 LEV 标准。尽管制造商对汽油发动机的催化剂持乐观态度，但对于柴油催化剂他们认为任重道远。

manufacturers are optimistic about such catalysts for gasoline engines, they consider a diesel catalyst to be a much more difficult challenge.	
Battery Technologies	电池技术
The battery is the critical technology for electric vehicles, providing both energy and power storage. Unfortunately, the weak link of batteries has been their low energy storage capacity-on a weight basis, lower than gasoline by a factor of 100 to 400. Power capacity may also be a problem, especially for some of the higher temperature and higher energy batteries. In fact, power capacity is the more crucial factor for hybrid vehicles, where the battery's major function is to be a load leveler for the engine, not to store energy. Aside from increasing energy and power storage, other key goals of battery R&D are increasing longevity and efficiency and reducing costs.	电池是电动汽车的关键技术，可提供能量和动力储存。遗憾的是，电池的薄弱环节一直是储能能力低--按重量计算，比汽油低 100 到 400 倍。功率容量也可能是一个问题，特别是对于一些温度较高和能量较高的电池。事实上，对于混合动力汽车来说，功率容量是更关键的因素，因为在混合动力汽车中，电池的主要功能是作为发动机的负载均衡器，而不是储存能量。除了增加能量和功率存储外，电池研发的其他主要目标还包括延长寿命、提高效率和降低成本。
Numerous battery types are in various stages of development. Although there are multiple claims for the efficacy of each type, there is a large difference between the performance of small modules or even full battery packs under nondemanding	众多类型的电池正处于不同的开发阶段。虽然每种电池的功效都有多种说法，但小型模块甚至完整电池组在非苛刻的实验室测试中的性能，与在实际车辆使用的挑战性环境中的性能，或在模拟这种情况而设计的测试中的性能，两者之间存在很大差异。虽然美国先进电池联盟正在赞助此类测试，但主要结果是保密的，而且大部分公开信息来自电池制

laboratory tests, and performance in the challenging environment of actual vehicle service or tests designed to duplicate this situation. Although the U.S. Advanced Battery Consortium is sponsoring such tests, the key results are confidential, and much of the publicly available information comes from the battery manufacturers themselves, and may be unreliable. Nevertheless, it is quite clear that a number of the batteries in development will prove superior to the dominant conventional lead acid battery, though at a higher purchase price. Promising candidates include advanced lead acid (e.g., woven-grid semi-bipolar and bipolar) with specific energy of 35 to 50 Wh/kg, specific power of 200 to 900 W/kg, and claimed lifetimes of five years and longer; nickel metal hydride with 80 Wh/kg and 200 W/kg specific energy and power, and claimed very long lifetimes; lithium polymer, considered potentially to be an especially “EV friendly” battery (they are spillage proof and maintenance free), that claims specific energy and power of 200 or more Wh/kg and 100 or more W/kg;	造商本身，可能并不可靠。不过，很明显，一些正在开发的电池将被证明优于占主导地位的传统铅酸电池，尽管购买价格较高。前景看好的候选产品包括先进的铅酸（如编织栅半双极型和双极型），其比能量为 35 至 50 Wh/kg，比功率为 200 至 900 W/kg，据称使用寿命为 5 年或更长；镍金属氢化物比能量和比功率分别为 80 Wh/kg 和 200 W/kg，据称寿命很长； 锂聚合物电池，被认为是一种特别 ″适合电动汽车 ″的电池（防溢出、免维护），比能量和比功率分别为 200 或更多 Wh/kg 和 100 或更多 W/kg；锂离子电池，比能量为 100 至 110 Wh/kg；以及许多其他电池。在车辆应用中，电池寿命的声称值应被视为极不确定。除了一些即将问世的先进铅酸电池外，每种电池在商业化方面都面临着巨大的挑战--高成本、腐蚀和热管理问题、充电过程中的气体积聚等。此外，电池商业化的历史表明，将电池推向市场需要一个漫长的试用期：一旦电池超越了单体电池阶段，就需要近十年或更长时间的测试，才能被视为成熟的生产模式。

lithium-ion, which has demonstrated specific energy of 100 to 110 Wh/kg; and many others. The claimed values of battery lifetime in vehicle applications should be considered extremely uncertain. With the possible exception of some of the very near-term advanced lead acid batteries, each of the battery types has significant remaining challenges to commercialization—high costs, corrosion and thermal management problems, gas build-up during charging, and so forth. Further, the history of battery commercialization demonstrates that bringing a battery to market demands an extensive probationary period: once a battery has moved beyond the single cell stage, it will require a testing time of nearly a decade or more before it can be considered a proven production model.	
Non-battery Energy Storage: Ultracapacitors and Flywheels	非电池储能： 超级电容和飞轮
Ultra-capacitors are devices that can directly store electrical charges—unlike batteries, which store electricity as chemical energy. A variety of ultracapacitor materials and designs are being investigated, but all share some	超级电容器是一种可以直接存储电荷的装置，与以化学能形式存储电能的电池不同。目前正在研究的超级电容器材料和设计多种多样，但都有一些共同的基本特征--比功率非常高，大于 1 kW/kg，同时比能量较低。美国能源部的中期目标仅为 10 Wh/kg（相比之下，美国先进电池联盟的中期电池目标为 100 Wh/kg）。 超级电容器的其他特点是存

basic characteristics-very high specific power, greater than 1 kW/kg, coupled with low specific energy. The U.S. Department of Energy mid-term goal is only 10 Wh/kg (compared to the U.S. Advanced Battery Consortium midterm battery goal of 100 Wh/kg). Other likely ultracapacitor characteristics are high storage efficiency and long life.	储效率高和寿命长。
Ultracapacitors’ energy and power characteristics define their role. In electric vehicles, their high specific power can be used to absorb the strong power surges of regenerative braking, to provide high power for brief spurts of acceleration, and to smooth out any rapid changes in power demand from the battery in order to prolong its life. In hybrids, they theoretically could be used as the energy storage mechanism; however, their low specific energy limits their ability to provide a prolonged or repeatable power boost. Increasing ultracapacitors’ specific energy is a critical research goal.	超级电容器的能量和功率特性决定了其作用。在电动汽车中，超级电容器的高比功率可用于吸收再生制动时产生的强大功率浪涌，为短暂的急加速提供高功率，并平滑电池功率需求的任何快速变化，以延长电池的使用寿命。在混合动力汽车中，理论上可以使用超级电容器作为储能装置；但是，超级电容器的低比能量限制了其提供长时间或可重复动力提升的能力。提高超级电容器的比能量是一个重要的研究目标。
A flywheel stores energy as the mechanical energy of a rapidly spinning mass, which rotates on virtually frictionless bearings in a near-vacuum	飞轮将能量储存为快速旋转质量的机械能，质量在近乎真空的环境中通过几乎无摩擦的轴承旋转，从而将损耗降至最低。飞轮本身可以作为电机/发电机的转子，因此可以根据需要将机械能转化为电能，反之亦然。与超级电容器一样，

environment to minimize losses. The flywheel itself can serve as the rotor of an electrical motor/generator, so it can turn its mechanical energy into electricity or vice versa, as needed. Like ultracapacitors, flywheels have very high specific power ratings and relatively low specific energy, though their energy storage capacity is likely to be higher than ultracapacitors. Consequently, they may be more practical than ultracapacitors for service as the energy storage mechanism in a hybrid. In fact, the manufacturer of the flywheel designed for Chrysler’s Patriot race car, admittedly a very expensive design, claims a specific energy of 73 Wh/kg, which would make the flywheel a very attractive hybrid storage device. Mass-market applications for flywheels depend on solving critical rotor manufacturing issues, and, even if these issues were successfully addressed, it is unclear whether mass- produced flywheels could approach the Patriot flywheel’s specific energy level.	飞轮具有很高的额定比功率和相对较低的比能量，但其储能能力可能高于超级电容器。因此，飞轮作为混合动力车的储能装置可能比超级电容器更实用。事实上，为克莱斯勒赛车设计飞轮的制造商声称，这种飞轮的比能量为 73 Wh/kg，是一种非常有吸引力的混合动力储能装置。飞轮的大规模市场应用取决于关键转子制造问题的解决，即使成功解决了这些问题，目前还不清楚大规模生产的飞轮能否接近爱国者飞轮的比能量水平。
Technologies for Advanced Vehicles Performance and Cost Expectations	先进汽车技术的性能和成本预期
This chapter discusses the technical	本章将讨论 2005 年和 2015 年（或更早）可能商业化的一系列先进汽车技术

potential and probable costs of a range of advanced vehicle technologies that may be available for commercialization by 2005 and 2015 (or earlier). As noted, projections of performance and cost can be highly uncertain, especially for technologies that are substantially different from current vehicle technologies and for those that are in a fairly early stage of development. In addition, although substantial testing of some technologies has occurred- -for example, the Advanced Battery Consortium has undertaken extensive testing of new battery technologies through the Department of Energy's national laboratories--the results are often confidential, and were unavailable to the Office of Technology Assessment (OTA). Nevertheless, there is sufficient available data to draw some preliminary conclusions, to identify problem areas, and to obtain a rough idea of what might be in store for the future automobile purchaser, if improving fuel economy were to become a key national goal.	的技术潜力和可能成本。如前所述，对性能和成本的预测可能会有很大的不确定性，特别是对于那些与当前车辆技术有很大不同的技术和那些处于相当早期开发阶段的技术。此外，尽管对某些技术进行了大量测试--例如，先进电池联盟通过能源部的国家实验室对新电池技术进行了广泛测试--但测试结果往往是保密的，技术评估办公室（Office of Technology Assessment; OTA）无法获得这些结果。尽管如此，如果提高燃油经济性成为一项重要的国家目标，还是有足够的可用数据来得出一些初步结论，找出问题所在，并大致了解未来汽车购买者可能会遇到的问题。
The chapter discusses two groupings of technologies:	本章将讨论两类技术：

1. Technologies that reduce the tractive forces that a vehicle must overcome, from inertial forces associated with the mass of the vehicle and its occupants, the resistance of the air flowing by the vehicle, and rolling losses from the tires (and related components); and 2 .Technologies that improve the efficiency with which the vehicle transforms fuel (or electricity) into motive power, such as by improving engine efficiency, shifting to electric drivetrains, reducing losses in transmissions, and so forth.	1. 减少车辆必须克服的牵引力的技术，这些牵引力来自与车辆及其乘员的质量有关的惯性力、车辆所受的气流阻力以及轮胎（及相关部件）的滚动损失；以及 2. 提高车辆将燃料（或电力）转化为动力效率的技术，如提高发动机效率、改用电力传动系统、减少变速箱损耗等。
Technologies that reduce energy needs for accessories, such as for heating and cooling, can also play a role in overall fuel economy--especially for electric vehicles--but are not examined in depth here. Some important technologies include improved window glass to reduce or control solar heat input and heat rejection; technologies for spot heating and cooling; and improved heat pump air conditioning and heating.	减少额外能源需求的技术，如供暖和制冷技术，也可以在整体燃油经济性方面发挥作用--尤其是电动汽车，但在此不作深入探讨。一些重要的技术包括：可减少或控制太阳热量输入和热量排出的改进型窗玻璃；定点加热和冷却技术；以及改进型热泵空调和加热技术。
Weight Reduction With Advanced Materials And Better Design	通过先进材料和更佳设计以减轻重量
Weight reduction has been a primary	在过去的二十年里，减重一直是提高汽车燃油经济性的主要措施。1976 年至

component of efforts to improve automobile fuel economy during the past two decades. Between 1976 and 1982, in response to federal Corporate Average Fuel Economy (CAFE) regulations, automakers managed to reduce the weight of the steel portions of the average auto from 2,279 to 1,753 pounds by downsizing the fleet and shifting from body-on-frame to unibody designs. Future efforts to reduce vehicle weights will focus both on material substitution--the use of aluminum, magnesium, plastics, and possibly composites in place of steel--and on optimization of vehicle structures using more efficient designs.	1982 年间，为响应联邦公司平均燃油经济性（CAFE）法规，汽车制造商通过缩减车身大小，从车身框架设计转向一体式车身设计，成功地将普通汽车的钢制部分重量从 2,279 磅减至 1,753 磅。未来减轻汽车重量的工作重点将放在材料替代上--使用铝、镁、塑料以及可能的复合材料来替代钢材--以及使用更高效的设计来优化汽车结构。
Although there is widespread agreement that improved designs will play a significant role in weight reduction, there are several views about the role of new materials. On the one hand, a recent Delphi study based on interviews with auto manufacturers and their suppliers projects that the vehicle of 2010 will be composed of materials remarkably similar to today's vehicles. At the other extreme, some advocates claim that the use of strong, lightweight polymer composites	人们普遍认为改进设计将在减轻重量方面发挥重要作用，但对新材料的作用却有不同看法。一方面，德尔福（Delphi）公司最近根据对汽车制造商及其供应商的采访进行的一项研究预测，2010 年的汽车将由与今天的汽车极为相似的材料构成。另一个极端是，一些倡导者声称，目前用于战斗机、体育用品和赛车的高强度、轻质聚合物的使用，再加上其他牵引负荷的减少和动力系统的缩小，很快就能使车辆总重减少 65% 到 75%。下文将讨论影响汽车材料和设计选择的因素。

such as those currently used in fighter aircraft, sporting goods, and race cars, coupled with other reductions in tractive loads and downsized powertrains, will soon allow total weight reductions of 65 percent to 75 percent. The factors that influence the choices of vehicle materials and design are discussed below.	
Vehicle Design Constraints	车辆设计的限制因素
The most important element in engineering design of a vehicle is past experience. Vehicle designs almost always start with a consideration of past designs that have similar requirements. Designers rarely start from "blank paper," because it is inefficient for several reasons:	车辆工程设计中最重要的因素是过去的经验。车辆设计几乎总是从考虑具有类似要求的以往设计开始。设计师很少从"白纸"开始设计，因为这样做效率很低，原因有以下几点：
· Time pressure. Automakers have found that, as with so many other industries, time to market is central to market competitiveness. While tooling acquisition and facilities planning are major obstacles to shortening the development cycle, they tend to be outside the direct control of the automaker. Design time, however, is directly under the control of the automaker, and reduction of design time has, therefore,been a major	- 时间压力。汽车制造商发现，与许多其他行业一样，上市时间是市场竞争力的核心。虽然工具购置和设施规划是缩短开发周期的主要障碍，但它们往往不在汽车制造商的直接控制范围内。而设计时间则直接受汽车制造商的控制，因此缩短设计时间一直是汽车开发的主要目标。

goal of vehicle development.	
· Cost pressures. The reuse of past designs also saves money. In addition to the obvious time savings above, the use of a proven design means that the automaker has already developed the necessary manufacturing capability (either in-house or through purchasing channels). Furthermore, because the established component has a known performance history, the product liability risk and the warranty service risk is also much reduced.	- 成本压力。重复使用过去的设计也能节省成本。除了上述显而易见的时间节省之外，使用成熟的设计还意味着汽车制造商已经具备了必要的制造能力（内部制造或通过采购渠道）。 此外，由于成熟的部件具有已知的性能历史，产品责任风险和保修服务风险也大大降低。
· Knowledge limitations. Automakers use a various analytical methods (e.g., finite element codes) to calculate the stresses in a structure under specified loading. They have only a rough idea, however, of what the loads are that the structure will experience in service. Thus, they cannot use their analytical tools to design the structure to handle a calculated limiting load. Given this limitation, it is far more efficient to start with a past design that has proven to be successful, and to modify it to meet the geometric limitations of the new vehicle. The	- 知识水平限制。汽车制造商使用各种分析方法（如有限元代码）来计算结构在特定载荷下的应力。然而，他们对结构在使用中将承受的载荷只有一个粗略的概念。 因此，他们无法使用分析工具来设计结构，以应对计算出的极限荷载。鉴于这种局限性，更有效的做法是从过去已被证明成功的设计开始，对其进行修改以满足新车的几何限制。修改后的设计可以通过原型设计和道路测试来支持。

modified design can then be supported with prototyping and road testing.	
This normative design process has been central to automobile design for decades. Although it , has generally served the automakers well, it also has some limitations. In particular, this strategy is unfriendly to innovations such as the introduction of new materials in a vehicle design. The advantages of a new material stem directly from the fact that it offers a different combination of performance characteristics than does a conventional material. If the design characteristics are specified in terms of a past material, however, that material will naturally emerge as the “best” future material for that design. In other words, if a designer says, “Find me a material that is at least as strong as steel, at least as stiff as steel, with the formability of steel, and costing no more than steel for this design that I derived from a past steel design,” the obvious materials choice is steel.	几十年来，这种规范化的设计流程一直是汽车设计的核心。虽然这种方法总体上对汽车制造商很有帮助，但也有一些局限，尤其是不利于创新。例如在汽车设计中引入新材料。新材料的优势源于它提供了与传统材料不同的性能特征组合。然而，如果设计特性是根据过去的材料来指定的，那么这种材料就会自然而然地成为未来该设计的 ″最佳 ″材料。换句话说，如果设计者说：″给我找一种材料，它的强度至少与钢材相当，刚度至少与钢材相当，具有钢材的可成形性，而且成本不高于钢材，用于我从过去的钢材设计中衍生出来的设计″，那么材料的选择显然就是钢材。