2018 ICM
Problem D: Out of Gas and Driving on E (for electric, not empty)

For both environmental and economic reasons, there is global interest in reducing the use of fossil fuels, including gasoline for cars. Whether motivated by the environment or by the economics, consumers are starting to migrate to electric vehicles. Several countries are seeing early signs of the potential for rapid growth in the adoption of electric vehicles. In the US and other countries, the release of the more affordable all-electric Tesla Model 3 has resulted in record numbers of pre-orders and long wait lists (https://www.wired.com/story/tesla-model-3-delivery-timeline/). To further accelerate the switch to electric vehicles, some countries, including China, have announced that they will ban gasoline and diesel cars in the coming years (http://money.cnn.com/2017/09/11/news/china-gas-electric-car-ban/index.html).

Eventually, when a ban goes into effect, there needs to be a sufficient number of vehicle charging stations in all the right places so that people can use their vehicles for their daily business, as well as make occasional long-distance trips. The migration from gasoline and diesel cars to electric vehicles, however, is not simple and can't happen overnight. In a fantasy world, we would wake up one day with every gas vehicle replaced by an electric one, and every gas station replaced with a charging station. In reality, there are limited resources, and it will take time for consumers to make the switch. In fact, the location and convenience of charging stations is critical as early adopters and eventually mainstream consumers volunteer to switch (http://www.govtech.com/fs/Building-Out-Electric-Vehicle-Infrastructure-Where-Are-the-Best-Locations-for-Charging-Stations.html).

As nations plan this transition, they need to consider the final network of charging stations (the number of stations, where they will be located, the number of chargers at the stations, and the differences in the needs of rural areas, suburban areas, and urban areas), as well as the growth and evolution of the network of charging stations over time. For example, what should the network look like when electric vehicles represent 10% of all cars, 30% of all cars, 50% of all cars, and 90% of all cars?

As nations seek to develop policies that promote the migration towards electric vehicles, they will need to design a plan that works best for their individual country. Before they can begin, they would like your team's help in determining the final architecture of the charging network to support the full adoption of all-electric vehicles. Additionally, they would like you to identify the key factors that will be important as they plan their timeline for an eventual ban or dramatic reduction of gasoline and diesel vehicles.

To help your team manage the scope of this problem, we ask that you focus only on personal passenger vehicles (i.e. cars, vans, and light trucks used for passengers). At the end of your report, you may briefly comment on the relevance of your findings and conclusions on commercial vehicles to include heavy trucks and busses.

Your tasks are the following:

Task 1: Explore the current and growing network of Tesla charging stations in the United States. Tesla currently offers two types of charging stations: (1) destination charging designed for charging for several hours at a time or even overnight (https://www.tesla.com/destination-charging); and (2) supercharging designed for longer road trips to provide up to 170 miles of range in as little as 30 minutes of charging (https://www.tesla.com/supercharger). These stations are in addition to at-home

charging used by many Tesla owners who have a personal garage or a driveway with power. Is Tesla on track to allow a complete switch to all-electric in the US? If everyone switched to all-electric personal passenger vehicles in the US, how many charging stations would be needed, and how should they be distributed between urban, suburban, and rural areas?

Task 2: Select one of the following nations (South Korea, Ireland, or Uruguay).

2a. Determine the optimal number, placement, and distribution of charging stations if your country could migrate all their personal passenger vehicles to all-electric vehicles instantaneously (no transition time required). What are the key factors that shaped the development of your plan?

2b. While these countries have already started installing chargers, you get to start with a clean slate. Present a proposal for evolving the charging network of your chosen country from zero chargers to a full electric-vehicle system. How do you propose the country invest in chargers? Should the country build all city-based chargers first, or all rural chargers, or a mix of both? Will you build the chargers first and hope people buy the cars, or will you build chargers in response to car purchases? What are the key factors that shaped your proposed charging station plan?

2c. Based on your growth plan, what is the timeline you propose for the full evolution to electric vehicles in your country? To get started, you may wish to consider how long it will take for there to be 10% electric vehicles, 30% electric vehicles, 50% electric vehicles, or 100% electric vehicles on your selected country's roads. What are the key factors that shaped your proposed growth plan timeline?

Task 3: Now consider countries with very different geographies, population density distributions, and wealth distributions, such as Australia, China, Indonesia, Saudi Arabia, and Singapore. Would your proposed plan for growing and evolving the network of chargers still apply to each of these countries? What are the key factors that trigger the selection of different approaches to growing the network? Discuss the feasibility of creating a classification system that would help a nation determine the general growth model they should follow in order for them to successfully migrate away from gasoline and diesel vehicles to all electric cars.

Task 4: The technological world continues to change and is impacting transportation options such as car-share and ride-share services, self-driving cars, rapid battery-swap stations for electric cars, and even flying cars and a Hyperloop. Comment on how these technologies might impact your analyses of the increasing use of electric vehicles.

Task 5: Prepare a one-page handout written for the leaders of a wide range of countries who are attending an international energy summit. The handout should identify the key factors the leaders should consider as they return to their home country to develop a national plan to migrate personal transportation towards all-electric cars and set a gas vehicle-ban date.

Your submission should consist of:

- One-page Summary Sheet,
- One-page handout,
- Your solution of no more than 20 pages, for a maximum of 22 pages with your summary and handout.
- Note: Reference list and any appendices do not count toward the 22-page limit and should appear after your completed solution.

2018年美赛D题翻译
停止使用燃气和用电驾驶（电，不是空的）

由于环境和经济原因，全球都有兴趣减少使用化石燃料，包括汽车用汽油。无论是受环境或经济动机，消费者开始转向电动汽车。几个国家正在看到采用电动汽车快速增长的潜力。在美国和其他国家，更经济实惠的全电式特斯拉 3 型车型的发布带来了预购订单和长期等待名单的记录（https://www.wired.com/story/tesla-model-3-delivery-timeline/）。为了进一步加快向电动汽车的转型，包括中国在内的一些国家已经宣布将在未来几年内禁止汽油和柴油车（http://money.cnn.com/2017/09/11/news/china-gaselectric-car-ban/index.html）。最终，禁令生效时，要在所有的地方都有充足的车辆充电站，以便人们可以把车辆用于日常事务，也可以进行偶尔的长途旅行。然而，从汽油车和柴油车到电动车的过渡并不是一帆风顺的，不能一蹴而就。在一个幻想的世界里，我们会有一天醒来，每一辆汽车都换上一辆电动汽车，每一辆加油站都换上一个充电站。实际上资源有限，消费者需要时间进行转换。事实上，充电站的位置和方便性对于早期使用者以及最终主流消费者自愿切换是至关重要的（http://www.govtech.com/fs/Building-Out-ElectricVehicle-Infrastructure-Where-Are-the-Best-Locations-for-Charging-Stations.html）。

当国家计划这一转型时，他们需要考虑充电站的最终网络（车站的数量，所在的位置，车站充电器的数量以及农村，郊区的需求的差异，以及城市地区）以及充电站网络的发展和演变。例如，当电动汽车占所有汽车的 10％，所有汽车的 30％，所有汽车的 50％以及所有汽车的 90％时，网络应该如何？

随着各国寻求制定促进向电动汽车过渡的政策，他们将需要制定一个最适合其个别国家的计划。在他们开始之前，他们希望您的团队帮助确定充电网络的最终架构，以支持全电动车辆的全面采用。此外，他们希望您确定在规划最终禁止汽油车辆和柴油车辆大幅度减少的时间表时将起重要作用的关键因素。

为了帮助您的团队管理这个问题的范围，我们要求您只关注个人乘用车（即用于乘客的轿车，货车和轻型卡车）。在你的报告结尾，你可以简要地评论你的发现和商业车辆的结论的相关性，包括重型卡车和公共汽车。

您的任务如下：

任务 1：探索美国当前日益增长的特斯拉充电站网络。特斯拉目前提供两种类型的充电站：（1）目的地充电设计为一次或甚至一夜充电数小时（https://www.tesla.com/destination-charging）;和（2）增压设计用于长途旅行，在短短 30 分钟的充电时间内提供 170 英里的行驶里程（https://www.tesla.com/supercharger）。除了拥有私人车库或车道的许多特斯拉车主所使用的这些车站之外，这些车站也是如此。特斯拉正走在美国的一个完全切换到全电的轨道上吗？如果每个人都在美国转而使用全电动个人乘用车，那么需要多少个充电站，又如何在城市，郊区和农村之间进行分配呢？

任务 2：选择下列国家之一（南韩，爱尔兰或乌拉圭）。

2a.确定充电站的最佳数量，布局和分布，如果您的国家可以将所有个人乘用车瞬间迁移到全电动汽车（不需要过渡时间）。影响你计划发展的关键因素是什么？

2b.当这些国家已经开始安装充电器的时候，你可以从一个干净的石板开始。提出将您所选择的国家的充电网络从零充电器发展到全电动车系统的建议。你如何

提出该国投资于充电器？该国是否应该首先建立所有城市的充电器，或者所有的农村充电器，还是两者兼而有之？你会先建立充电器，并希望人们购买汽车，或者你会建立充电器，以应付汽车购买？建议的充电站计划的关键因素是什么？

2c.根据你的成长计划，你提出的全面演进的时间表是什么？你们国家的电动汽车？要开始，你不妨考虑要花多长时间有 10％的电动车，30％的电动车，50％的电动车，或 100％的电动车在您选择的国家道路上。什么是影响您提出的增长计划时间表的关键因素？

任务 3：现在考虑具有非常不同地理位置，人口密度分布和地理位置的国家澳大利亚，中国，印度尼西亚，沙特阿拉伯和新加坡等财富分布。你提出的增长和发展收费者网络的计划仍然适用于每个这些国家吗？触发选择不同增长网络的关键因素是什么？讨论建立一个帮助一个国家确定的分类体系的可行性他们应该遵循一般的增长模式，以便他们成功地从汽油中迁移出来和柴油车到所有电动车。

任务 4：技术世界不断变化，正在影响交通选择，如汽车共享和乘车分享服务，自驾车，电动汽车的快速换电站等即使是飞行的汽车和超环。评论这些技术如何影响你的分析电动车的使用日益增多。

任务 5：为广泛的国家的领导人准备一份单页的执行计划参加国际能源峰会。执行计划应该确定领导者的关键因素应当考虑返回本国制定国家移民个人计划运输全电动汽车，并设置禁止汽油的日期。

您的提交应该包括：

- 单页摘要，
- 单页执行计划，
- 您的解决方案不超过 20 页，最多 22 页的摘要和执行计划。

🎬注意：参考列表和任何附录不计入 22 页的限制，应该这样做在完成解决方案后出现。