A Background Guide for the

Special Summit on Futuristic Technology

Harvard Model United Nations

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Harvard Model United Nations

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A LETTER FROM THE UNDER-SECRETARY-GENERAL

Dear Delegates,

It is my pleasure to welcome you to Harvard Model United Nations 2018! The staff members of the General Assembly have been working for months to bring to life nine exciting, innovative, challenging, and educational committees; and I'm thrilled that the day is approaching when you will all arrive in Boston to experience them. These committees are intended to push the envelope of what General Assemblies do – test the most experienced delegates, and create room for those with no background in model UN at all to offer creative solutions to pressing concerns.

I had never participated in model UN before coming to Harvard. As a freshman, before I staffed and participated in a General Assembly, I was incredibly intimidated by its size, and the substantive knowledge expected of me. To all those who, like me, are nervous about these aspects – don't be. I have found such a strong community in the General Assembly, from directors and moderators who have served as mentors and role models, to the fellow delegates coming from all around the world who I have become good friends with. I have learnt so much on a variety of topics that have been invaluable to my academic

pursuits and helped shape what I want to do with the rest of my life. I hope all of you have a similarly rewarding experience in the General Assembly at HMUN this year, and know that all of our directors, moderators, and assistant directors are here to help foster this enriching environment.

HMUN's conference theme this year is "Empowerment and Education". Our key goal is to empower you, the future leaders of the world, to think critically about the most pressing global issues now and in the future. In light of this, all committees in the General Assembly are running parallel to a real world crisis, an on-going problem that the international community is struggling with, and the impetus is on you as delegates to craft creative solutions that address the underlying problems, not just expressing your dismay at the situation in a speech.

In the time remaining until HMUN, please do not hesitate to reach out to your committee directors or me. We all want to help you have the most meaningful and rewarding weekend possible and would love to hear from you.

Best,

Neil Reilly
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Harvard Model United Nations

A LETTER FROM THE DIRECTOR

Dear Delegates,

On behalf of the Harvard International Relations Council, allow me to warmly welcome you to Harvard Model United Nations 2018! My name is Nicolas Weninger and I am very excited to be directing the General Assembly's Special Summit on Futuristic. I am originally from London – a short hop across the proverbial pond – and I am thoroughly looking forward to meeting each and every one of you in Boston this January!

Born and raised in London, I had the opportunity to visit the London Science Museum every weekend as a child. The immense aircraft landing gear at the main entrance and the roaring steam engine in the main hall not only peaked my interest in how these fascinating machines worked, but also just how much human endeavour, ingenuity and even policy is associated with them. That is the reason I am studying Engineering Sciences at Harvard and indeed why I am directing this Special Summit of the General Assembly.

I have witnessed the occasionally rowdy British Parliament vehemently debate matters of scientific policy, the unbelievable rate of technological development and the disconnect between technical and liberal arts education. Indeed, in this rapidly changing world, where technological developments will be impacting our lives in profound ways, one cannot sever one from the other. I hope that this committee gives you the opportunity to bridge this important gap. It illuminates this vital connection, and you will need to have the diplomatic prowess and technical knowledge to prevail – an often-overlooked combination of skills! This will not be an easy committee; the combination of science and policy is challenging, and the subtleties of this committee mean that you the delegates have just as much of a role to play as I do in crafting insightful and constructive discussions.

If nothing else, I want you to walk away from this conference feeling like you were challenged in new and engaging ways, gained an insight into the fascinating scientific developments that will define our futures, developed your public speaking and diplomatic skills and made close friends from across the globe. I can only hope that you are as excited about this committee as I am.

Please do not hesitate at all to reach out to me at any point with any questions or concerns you may have! I look forward to welcoming all of you to the Sheraton Hotel in Boston in January.

With kindest regards and best wishes for your trip to Boston,

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Introduction

In just a span of a few decades, the world has seen an unparalleled leap in the development of technology and science, never even conceived in human history. The mobile phones of today in your pockets would be able to fly the Apollo missions to the moon and back, while still letting you play Angry Birds; warfare has evolved from rifles and shells on the fronts to covertly attacking national infrastructure and scaring others into submission with the nuclear deterrent, and the manipulation of the very code of life – one's DNA – is now a distinct possibility.

With this seismic shift in technological capabilities, the structures and legislation in place have found themselves unable to resolve the challenges of the brave new world that we are living in with the traditions, moral convictions and persuasions of the post-war period and the era of the digital revolution. Much of the legislation that governs the technologies and practices were written at a time when the disruptive power of the internet, the understanding of our DNA and the networking of infrastructure were still in their infancy.

Changing this legislation on a national level to keep up with the ever-increasing rate of development has been a challenge. Andrea Matwyshyn, a professor at the University of Pennsylvania's Wharton Business School commented that legislation "is at least five years behind technology as it is developing"[1]. This is immediately evident, for example, in the way governments have placed pressure on messaging and voice-over-internet (VoIP) services such as Whatsapp and Viber, by blocking certain features at the request of incumbent telecommunications companies.[2] This perfectly demonstrates the disconnect between policymakers and the growing proliferation of a technology that is disrupting industries in ways no one foresaw only a few years ago.

What is important to note in these situations is that the restless march of development will continue, regardless of legislation or desire. The ethical issues of designer babies may convince some that further perusing research into genetics can only lead to disastrous outcomes, but the benefits to human life that we could gain by curing hereditary disease, preventing genetic malformations and possibly extending lifespan could outweigh the potential ethical qualms. Much like nuclear technologies, developments are neither good nor evil; it is us who decide how to use them. Trying to stop advancement will only delay the inevitable.

The first meeting of the Special Summit on Futuristic Technologies thus comes at a crucial time in history. With the advancement of Artificial Intelligence, and the resulting changing paradigms of employment, manufacturing, supply chain management and even current philosophy on the nature of consciousness, we must consider how can we prepare for a world after these drastic shifts through timely, sensible and practical legislation on an international stage. The special summit is tasked with developing this framework to prevent another scramble at the eleventh hour, like the international community did with the proliferation of nuclear technology,[3] and more recently with climate change; in the latter case, some claim that the agreement reached at the recent Paris climate talks "might not be enough, especially in terms of sea-level rise"[4], demonstrating the urgent need for early action on the pressing issues the committee will be considering.

With the advancement of Artificial Intelligence, and the resulting changing paradigms of employment, manufacturing, supply chain management and even current philosophy on the nature of consciousness, what happens when the United States is able to automate manufacturing to the extent that it begins to reduce opportunities for developing nations? Will the advance of AI widen the gap between nations? Should we be implementing policy to deal with the possibility of the singularity – the point in time when a machine is able to improve upon itself?

How do the changing power demands resulting from a shift to carbon neutral energy generation affect the geopolitical balance of the world? Will the advance of nuclear fusion generation result in a chasm between nations, and if so, should the techniques be shared in an international forum? How will we deal with the unstable nature of future energy generation in the form of smart grids? Should there be an agreed upon global framework to ensure that both energy and energy data can be shared multilaterally, or is energy still a vitally important pawn in international conflict?

How will new biotechnologies such as CRISPR (clustered regularly interspaced short palindromic repeats) change the conversation around bio-warfare?[5] What happens when a nation is able to change the very genetic code of its army or indeed its enemies? Is there now a desperate need for a second Geneva-Convention-like document to protect us from a weapon that could potentially be more destructive than the nuclear bomb itself?

Even with the very nature of war itself, how will we respond to new forms of engagement and the moral dilemmas that arise from automated killing? Beginning in the 21st Century, we have begun to see other forms of more sinister and equally as destructive forms of warfare. Stuxnet – a computer virus that impacted Iran's Nuclear power plants[6] – could have taken down an entire nation's power supply. Drones are already used, but what happens when the decision to pull the trigger no longer has a human in the loop, and what moral considerations are there to consider?

The world is rapidly changing and we risk falling behind. Much like the Cuban missile crisis unexpectedly arose from the conception of nuclear warfare, the world is prone to being plunged into uncertainty by these developments yet again. It is only by thinking through seemingly science-fiction-like developments that we will be able to have the foresight to prepare against possible threats to global peace. These are challenging questions, both technologically and philosophically, but history has the tendency to repeat itself. Let us not fail to learn from our past again.

Nothing is off limits in the Special Summit on Futuristic Technologies. The very fundamentals of the reach of international legislation remain to be challenged to ensure a safe future. Delegates will need to have both sound scientific and diplomatic knowledge to devise creative solutions and challenging compromises to these fascinating yet intimidating issues, with a sound understanding of their nation's scientific and political interests at play. However, what is to gain is not only global stability, but the reassurance that you have secured our future through what could be described as diplomacy's most testing time.

Crisis Elements

Model United Nations seeks to simulate international institutions, create solutions to some of the world's biggest problems, and develop an understanding of the difficulties and necessity of international cooperation. An understated difficulty of international cooperation at the United Nations or any other international institution is the repeated occurrences of continual crises. While addressing these crises, international institutions must not lose sight of the big issues. Accounting for these concerns, all General Assembly committees this year will have an on-going crisis element over the course of the conference.

Whether it is a twitter feed of the latest breaking news surrounding your topic, an expert witness who comes to deliver new information to the committee, or a brewing conflict somewhere in the world, delegates will have to adapt the policies they are discussing to address whatever crisis they're faced with. Your working papers should thoughtfully consider the best course of action to resolve the crisis, your speeches should be cognizant of its impact on the topic you're discussing, and a draft resolution should address the underlying issues behind it.

Your engagement with these crises should not be nominal – it should affect how you think about the topic. Carefully consider how your country would respond, and what is in its best interest. Your ability to adapt to crisis and show knowledge of the topic, and craft policies to redress it will be a factor in how Directors and the dais assess your performance in committee. More than this though, we want delegates in the GA to learn new skills from these crisis elements – flexibility, quick-thinking, negotiation, and the need for a greater substantive engagement with the committee topics themselves.

The Special Summit on Futuristic Technologies will be using elements of crisis to promote and steer discussion. Be prepared to respond to breaking news updates about global events, public reaction to committee action, and breakthrough discoveries in diffident technical and scientific fields that delegates will need to consider and respond to accordingly. As in any real-world simulation, validity, trustworthiness and contextual information should all be considered when presented with a crisis update. As citizens of an ever-interconnected world, maintaining a sceptical stance to new non-validated information is an important skill to possess.

While I do not expect delegates to pass resolutions, directives, or any other legislative effort to address the crises immediately or specifically, I do expect delegates to address the crises in committee, in how they negotiate agreements, mergers and working papers. Moderated caucuses should consider the impact of the crises on policies and what policies may need to be adjusted in light of the crisis. Ultimately, resolutions should be drafted with the consideration of how the proscribed series of policies and limitations could help address the crises.

When assessing the performance of delegates, I will be taking into consideration delegates' responsiveness to crisis updates, how crisis manifests itself in policy and appreciation for the broader impact of crisis updates on the topics of discussion.

Committee Dynamics

The Special Summit on Futuristic Technologies is a summit called outside the regular session of the UN General Assembly. Much of the operational aspects of this committee remain identical to a standing committee, such as the rules of procedure and voting members.[9] However, the Special Summit on Futuristic Technologies will require a two-thirds majority vote on any resolution it passes. This decision was reached with the appreciation that the measures set out in the resolution could have deep and long-lasting effects on both national and international levels. Each UN Member State will have one vote.

Delegates will be expected to deliver initial working papers throughout the conference, starting at thirteen to sixteen working papers in the first round of negotiations. Delegates will be expected to thoroughly engage in the spirit of diplomacy by merging working papers as ideas become more concrete policy proposals and voting blocs align interest. Given that this committee is operating on a two-thirds majority, up to two – potentially three – draft resolutions will be entertained. As such, delegates will need to carefully consider the process by which working papers can be merged to create a final resolution. Working papers will be accepted following the first unmoderated caucus and only towards the middle of Friday's morning session. Delegates are not expected to cover all topics in the first round of working papers. Merged working papers will be accepted towards the end of Friday's second session and will be expected to cover a wider range of topics. A third round of working papers may be entertained before draft resolutions are submitted towards the end of Saturday's sessions.

This committee has a unique focus on the intersection between science and policy. Delegates must bear this in mind when engaging in debate and writing policy proposals. Not only will delegates be required to clearly and politely communicate their policy ideas with other delegates and the dais, but do so with a concrete substantive framework.

History of the Committee

The Special Summit on Futuristic Technologies comes at a time when humanity is at a crossroad in history. With the recognition of the impact that technological developments will have on us, both personally and geopolitically, and in calling for this summit, the UN General Assembly demonstrated that it is concerned with the current lack of international cooperation and coordination surrounding these issues.

When the United States and the Soviet Union both developed the atom bomb after the Second World War, there existed "the possibility of an atomic arms race, the danger of atomic war, and the necessity for international control"[7]. The United Nations came into existence shortly thereafter and indeed the very first resolution passed in 1946 established a commission to deal with these threats and to ensure a peaceful future with the existence of nuclear energy.[8] This resolution paved the way for the peaceful uses of atomic energy that we all benefit greatly from today, and provided the foundation for international later agreements limiting the further proliferation of nuclear weapons, like the Nuclear Non-Proliferation Treaty.

This was a landmark event in the history of such a new technology. Not only was the United Nations created in the wake of its development, but also an international agreement was reached before matters got out of hand. This is what this Special Summit on Futuristic Technologies was called upon to do: to identify and begin proposing solutions to the problems raised by current technologies and their future developments, and to provide perspective with regards to the monumental changes that these developments will have on our global societies.

The Special Summit on Futuristic Technologies, unlike the UN General Assembly Committees, is unable to pass any binding legislation. The resolution it produces and hopefully passes will merely be an advisory document, recommending the passage of certain measures. If a resolution is passed, it is likely that it or a modified version of it will pass in the UN General Assembly.

Automation and Artificial Intelligence (AI)

Just a decade ago, no one would have ever guessed that the machines in factories that spend their days doing repetitive tasks, like bolting and welding car parts into place or moving toys along an assembly line would ever be able to do the creative work of crafting symphonies, showing empathy to patients, writing routine news stories, surgery, making financial trades and even winning *Jeopardy!*, yet alas we find ourselves facing the prospect of robots that can and have accomplished all of the above.[10] Therefore, it should come as no surprise that half of all US jobs will be susceptible to automation within the next two decades.[11] Automation of jobs will impact not just the economy and workforce of the United States, but those across the world. Will these developments create an ever-widening wealth and societal gap, or will the gains be shared amongst all people?

Such progress has been possible due to the evolving research and development into Artificial Intelligence (AI) technologies and governments around the world are investing heavily into AI research for a wide variety of reasons; Innovate UK has announced up to £10m in grant funding for businesses working on robotics and artificial intelligence (RAI) technologies designed for extreme and challenging environments.[12] As the capabilities of 'narrow AI' and 'general AI' – as discussed later – increase, it is inevitable that some, including Stephan Hawking himself, may forecast a gloomy future for humankind, calling it the "biggest mistake in human history" if these evolving capabilities were to be dismissed as science fiction.[13] However, amongst the popular depiction of *Terminator*-style robots destroying humanity, others believe that the transformations brought about by evolving digital technologies will be profoundly beneficial ones.[14]

AI and the impending automation economy are inextricably linked, but to sift through the claims of the prominent scientists that sit on both sides of the discussion, policymakers and international bodies need to understand why this is important on the international stage, the economics of innovation and the science behind AI. Thus, we must first take a dive into the unglamorous fundamentals of the innovation economy.

Innovation and the Automation Economy

Every human used to need to gather and grow food to survive, but as history has told us time and time again, if we can get someone else to do the job then we will. Combined with the fact that we have a large incentive to do so and have the intellectual capacity to create new inventions to assist in this endeavor, the population working in agriculture has fallen from nearly everyone to only a select few, and yet we still have never-before seen abundance.

These innovative technologies – from the plough to combine harvester, from the steam engine to the electric motor – made human work easier and productivity rose as a result. This allowed people to specialize and obtain better, higher-paying jobs.[15] The process of innovation of creating many new jobs and removing old ones generally has increased human welfare and reduced poverty in many areas of the world. However, like the Renaissance transition from feudal to wage labor challenged the ill equipped to keep up, the shift to automation will challenge all of us.

The question is whether innovation in the Information Age revolution will repeat the progress of the agricultural and industrial revolutions. In 1998, the number of hours worked by US workers was 194 billion. In 2013, that number had not increased, indicating that despite a rise in productivity and population levels, the number of new jobs being created is stagnant and seems unlikely to rise soon.[16] This has impacts not only in the United States but also across the globe. With the increased level of globalization and interdependencies between nations, job loss or stagnation in one industry can have disastrous effects on the global economy. As an extreme example, the Great Recession in 2008 saw a housing market collapse in the United States that impacted all nations as exports fell and unemployment rose.

This stagnation in productivity is partly due to the nature of new industries and the rise of the Internet. While some herald the Internet as an innovation on par with the advent and commercialization of electricity, it is by using this comparison that illuminates how innovation in the Information Age differs greatly from innovation in the past. The internet has allowed for businesses and services to propagate around the world: from Spotify in Stockholm to Google in Mountain View, they are used by millions around the world, yet are not producing enough jobs to keep up with population growth or to make up for those that are lost through disruption.[17] In 2004, Blockbuster Video employed 84,000 individuals. Netflix employs a twentieth at 4,500.[18] A similar comparison can be made between other innovative industries of the past. While the car utterly transformed our way of life, innovations such as electric cars are unlikely to create as many jobs as the burgeoning car industry – and all industries associated with it – once did.

The Internet and the globalized economy have brought about a winner-takes-all situation. It is hard to compete with J.K. Rowling or AirBnB, as technology has allowed for the replication of the top-quality producer at no effective cost: the best brick layer is able to be as gainfully employed as the tenth best brick layer, but no one will want to use the tenth best mapping application. Thus, human labor, once intimately associated with development, is now decoupling from productivity. The Committee on the Triple Revolution, created by US President Johnson in 1964 to evaluate the future impacts of nuclear proliferation, civil rights reform and automation, commented “The industrial system was designed to produce an ever-increasing quantity of goods as efficiently as possible, and it was assumed that the distribution of the power to purchase these goods would occur almost automatically”.[19] The economic problem is now no longer a question of how we increase production, but how to distribute the value that will be created through increased automation.

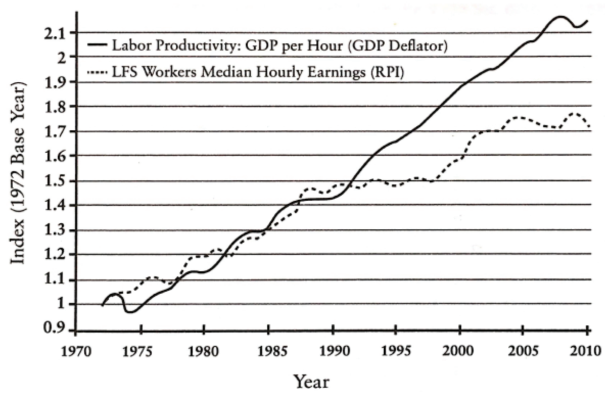


Figure 1. UK Growth of Real Median Household Salaries vs. Growth in Labor Productivity. (Source: Ford, The Rise of the Robots)

While this committee was ahead of its time, The Futurist Martin Ford identified six trends in the global economy that support the claim that innovation in the current Information Age is no longer consistent with past historic trends: stagnating wages, decline in labor’s share of national income in many countries while corporate profits increased (in violation of one of Economics’ fundamental principles that the share of a country’s economic output given to employees remains constant over time),[20] declining job creation, longer joblessness, rising inequality, declining incomes and underemployment for university graduates and a loss of middle-class jobs.[21] Further, the suggestion that creative professions will be safe is poorly evidenced. Indeed, computers have composed music that is indistinguishable from that written by humans and IBM Watson is diagnosing patients better than human doctors.[22,23] These trends suggest that the current economic paradigm of offering our labor for compensation may not be feasible over time. Companies may become increasingly unwilling to pay acceptable wages that allows someone to maintain their standard of living. Consumer demand falls, which may lead to further wage deterioration and less investment in research, and a vicious cycle can take hold.

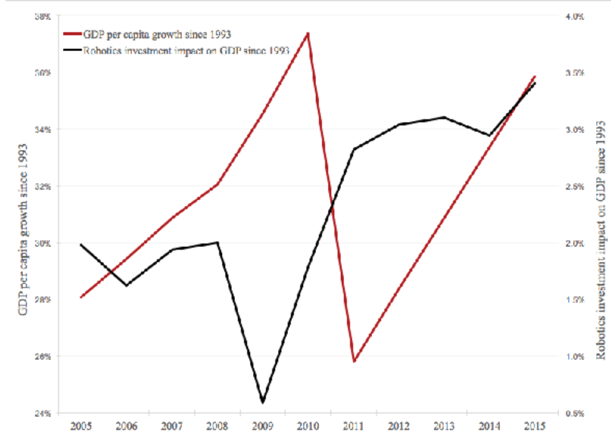


Figure 2. With the scales adjusted for clarity, a correlation between GDP per capita growth (a proxy for development of a country) and estimated contribution of robotics investment to cumulative GDP per capita growth. (Source: IFR, OECD, CEBR analysis)

Yet a tale of doom and gloom is not productive. Indeed, as pointed out by research scientists at MIT, a future of more human-machine cooperation (bearing in mind that we already are doing so) is the most fruitful way forward for our global community,[24] and through sensible policy and foresight, under- and unemployment can be avoided. TechCrunch – a popular technology news source – points out that “technology has been a major driver in helping keep companies competitive, so to shy away from it would surely only result in even greater domestic job loss” and paints a more positive image of the future.[25] Additionally, a review of recent related economic studies suggests that there is a positive relationship between robotics automation and economic development, as their data depicted below demonstrates.[26] The report goes so far as to claim that their evidence points towards robotic automation being a positive for employment. Ultimately, for now software can rhyme two lines but cannot write a poem that exhibits, as the poet Wordsworth put it, "the spontaneous overflow of powerful feelings, recollected in tranquility".

AI Development and Safety Concerns

In his TEDx talk titled 'AI – It Will Kill Us', journalist Jay Tuck states in no uncertain terms that "AI is dangerous and cannot be turned off" and that they will evolve to be "cold, cold, lions".[27] Elon Musk laments that the "government doesn't even have insight" and that we should be "extremely afraid".[28] While making a valid point about government officials tending to lack scientific insight, such emotive language by individuals not associated with AI research may obscure the real problems associated with evolving AI and associated prospects for automation.

Whereas previous automation consisted of large machines, blind to the world, the new automation paradigm has more sophisticated AI intimately associated with it. Baxter by Rethink Robotics is a robot that can observe a person doing a task and replicate it with accuracy and greater speed. It can even adapt to a changing environment, such as an object being moved from its initial position.[29] While still rudimentary, Baxter demonstrates just how far AI has come from the machines of the industrial revolution era. However, to think that we sit on the brink of the machines taking over the world does not help our thinking about concrete policy solutions to pressing issues currently.

It is thus important to review the burgeoning area of AI research from both a computational and philosophical perspective to better appreciate the extent to which concerns over a malicious AI are founded. Indeed, there could be a case to be made about implementing policy to address science-fiction-like developments at this stage, but to rely on those science-fiction stories is not as wise as relying on the research. As the founder of Rethink Robotics put it, "If you're going to have a regulation now, either it applies to something and changes something in the world, or it doesn't apply to anything. If it doesn't apply to anything, what the hell do you have the regulation for?".[30]

Perhaps the most famous Sci-Fi AI story is Asimov's *'I, Robot'*, in which 'The Three Laws of Robotics' are presented:

> A robot must not harm a human and it must not allow a human to come to harm through inaction.
>
> A robot must obey a human's order unless that conflicts with the first law.
>
> A robot must protect itself unless this protection conflicts with the first or second laws.

These three laws were created primarily to tell a good story. It is highly improbable that Asimov in 1950 was attempting to craft a complete set of AI principles, as shown by their catastrophic results. This field of the philosophical impacts and problems surrounding implementation of AI is termed AI Safety, and has attracted the attention of notable computer science researchers and philosophers alike. Stuart Russel, a University of California at Berkeley professor who wrote a seminal textbook on AI, sought collaboration with philosophers to identify an alternative set of three AI laws:[31]

> An AI's only objective is to maximize the realization of human values.
>
> The AI is initially uncertain about what these values are.
>
> Human behavior provides information about human values.

Yet these have their own associated issues. While they avoid the value-alignment problem of Asimov's laws – the robots aim to maximize human values and are humble or not too overly variant about doing so through the second law – the third law requires a cognition model that accounts for human limitations, such as criminal behavior or losing a game despite not wanting to. More than anything else, discussion about super-intelligent AI is making us question our societies and ourselves first.

Sam Harris – a neuroscientist and philosopher – points out the logical reasoning why thinking about AI safety matters. He notes that we will, given enough time and assuming our species survives, develop super-intelligent AI, given the following assumptions:[32]

> Intelligence is the product or information processing.
>
> We will continue to improve our machines.
>
> We are not near the summit of possible intelligence and computational power.

The idea of super-intelligent AI is intellectually very interesting, and one that could potentially cause issues that extend well beyond job losses due to automation, as Harris conjectures above. As Harris also points out, we cannot know how a super-intelligent – i.e. with super-human intelligence – would behave in the world, we do not know how long it would take to create the socio-economic structures for it to operate safely, and that such an AI possibly presents an existential threat.

However, AI does not only refer to the futuristic idea of a machine with super-human intelligence. Current AI applications range from email filtering, detection of network intruders or malicious insiders working towards a data breach, optical character recognition, search ranking, and

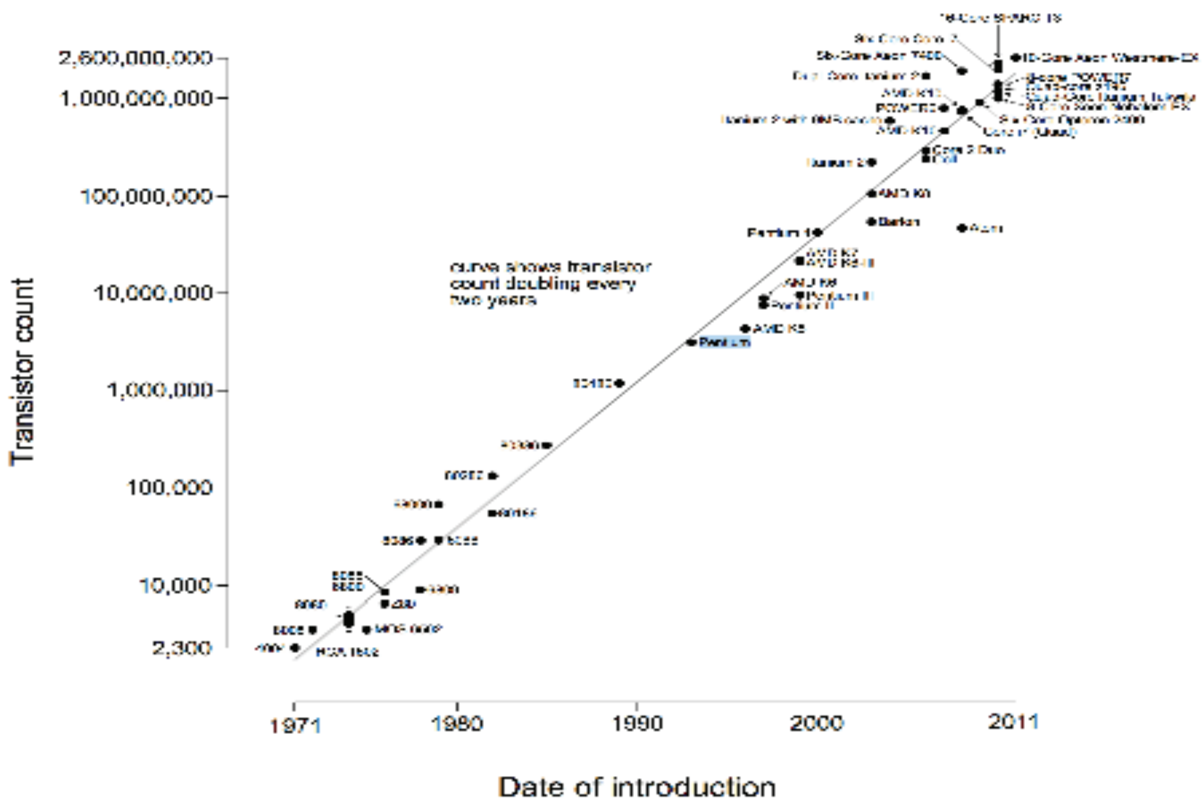


Figure 3. Microprocessor Transistor Counts 1971-2011. The y-axis is logarithmic, so the straight line demonstrates Moore's Law: the principle that the number of transistors on a chip will double every 18-24 months. If Harris's assumptions are valid, then whether or not Moore's Law persists is irrelevant. (Source: Wikimedia Foundation)

computer vision. All these are examples of 'narrow' or 'weak' AI: an AI that is focused on one narrowly defined task. By contrast, 'general' or 'strong' AI is the term given to an AI that can accurately simulate the human mind (and surpass it). While the current discussion surrounds narrow AI applications, general AIs do make us think about both the policy and philosophical consequences surrounding its development. However, many challenges need to be solved until general AI is even a remote possibility: even straightforward tasks like translation require reading and writing in both languages, reconstructing the author's argument, knowing the subject and context, and faithfully reproducing the author's original intent. While out of the scope of this committee, the Wikipedia pages on AI provide a good entry point into these discussions.

Concrete problems in AI research that affect current advanced AI implementations were outlined in a recent paper by researchers from Stanford and Google.[33] They use the example of a cleaning robot to illustrate this. The following list is a paraphrased copy of part of the paper:

Avoiding negative side effects: an objective function that focuses on only one aspect of the environment may implicitly express indifference over other aspects of the environment. The cleaning robot could destroy a dirty carpet as that is easier than cleaning it.

Avoiding reward hacking: reward or objective functions (the code that determines the internal reward for the completion of the task) try to capture the designer's informal intent, and sometimes these objective functions can be "gamed" by solutions that are valid in some literal sense but don't meet the designer's intent.

Scalable oversight: an AI may need to be walked through training situations to better understand the objective and reward functions. We do not have enough time to provide oversight for every training example; to train the AI well, we need to rely on approximations – how can we efficiently ensure that the cleaning robot respects aspects of the objective that are too expensive to be frequently evaluated during training?

Safe exploration: AIs need to sometimes engage in exploration (taking actions that do not seem ideal given current information, but which help the agent learn about its environment). However, exploration can be dangerous, since it involves taking actions whose consequences the AI does not understand well – the robot should experiment with mopping strategies, but putting a wet mop in an electrical outlet is a very bad idea.

Robustness to distributional shift: a key skill in dealing with novel situations is to recognize that the intuitions we have developed for other situations may not carry over perfectly. Machine learning systems also have this problem. A speech system trained on clean speech will perform very poorly on noisy speech, yet often be highly confident in its erroneous classifications – strategies our cleaning robot learned for cleaning an office might be dangerous on a factory floor.

There are many areas of AI research that could fill these pages several times over by themselves, but one specific area that all users of Facebook and Google have been exposed to and have fed data into is machine learning, where a computer is able to learn without being explicitly programmed. The current YouTube recommendation algorithm was never told how to associate keywords, video content and viewing history, but it has trained itself using input data from users to the extent that it behaves as a 'black box'.[34] As anyone who has spent hours going down the YouTube rabbit hole, it is quite effective. The AI textbook *Artificial Intelligence: A Modern Approach* discusses several methods in which this is done.[35] Four examples are highlighted here, although there are many more, to demonstrate the difference between supervised, unsupervised and partially supervised learning. Broadly, in supervised learning the computer is given a set of input variables (x) and an output variables (y) to learn the mapping function y = f(x) from the input to the output. In unsupervised learning, the computer is given the input variables but no corresponding outputs, and must attempt to model the underlying structure of the data. Partially supervised learning is a mixture of these two.

Decision tree learning: uses a decision tree as a predictive model, which maps observations about an item to conclusions about the item's target value. This is an example of supervised learning.

Clustering: the assignment of a set of observations into subsets. Different clustering techniques make different assumptions on the structure of the data. The data clustering could be defined by some similarity metric that is evaluated by similarity between members of the same cluster and separation between different clusters. Clustering is a method of unsupervised learning, and a common technique for statistical data analysis.

Artificial neural networks: a learning algorithm that is inspired by the structure and functional aspects of biological neural networks such as the brain. They are usually used to model complex relationships between inputs and outputs, to find patterns in data, or to capture the statistical structure in an unknown joint probability distribution between observed variables.

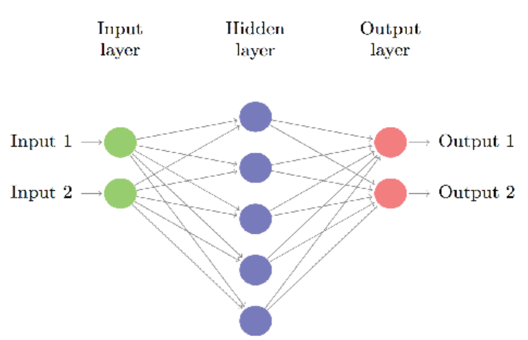


Figure 4. This is an example of a simple neural network with the input later, one hidden (processing) layer and the output later. Deep learning applications have several hidden layers. (Source: wildml.com)

Deep learning: consists of multiple hidden layers in an artificial neural network. This approach tries to model the way the human brain sensory inputs. Some successful applications of deep learning are computer vision and speech recognition. Google's image recognition algorithms and the YouTube algorithm mentioned above make use of deep neural networks. Deep learning is an example of partially supervised learning.

This information above has been included to provide scientific context about the state of current research into the wide field of AI. With this understanding, delegates are expected to make informed and rational policy decisions, rather than speculative or reactionary ones. Delegates will not be expected to be able to recount or debate the merits of learning methods or AI safety research.

Reform

It is important to note before engaging in a discussion about policy that much of the data in the previous section relates to high-income economies, seeing as this is where many of the advances are being seen; however, the discussion is by no means limited to these nations: shifts in consumer habits and technological advances have the ability to affect every nation on Earth differently. It is the task of the delegates to assess the impact of a changing technological landscape and establish where their efforts are best placed during debate. Manufacturing-focused economies face impending large-scale automation, and developing nations may face being left behind as their exports become less and less competitive due to increased cost pressure, brought about through a lack of access to new technologies.

This committee's task is not to solve AI safety problems through philosophical discussion, but rather to assess the urgency of the problem and ensure a coordinated response by setting the framework for current and future discussion. The sovereignty of nations will play a significant role in accepting or rejecting policy; it is the task of delegates to debate the extent to which international legislation is able to impact what has traditionally been something regulated internally only by states themselves or regional bodies like the European Union. It is highly unlikely – and indeed not the task of this committee – that delegates will be able to create new trade agreement or implement multilateral research regulation for example, but rather delegates will be expected to discuss the current state of affairs, uncover the potential global socioeconomic issues and to frame the discussion as to how future international legislative action could be implemented to tackle these issues.

Short-Term Reform

Within the next few years, it is improbable that automation will reach a level where all jobs will become automated. Indeed, it is the case that the low-skilled jobs will be automated first, thereafter requiring a significant advance in AI research for more creative or Science, Technology, Engineering, Mathematics (STEM) jobs to be automated.

On a unilateral level, each state can implement different policies to achieve this. However, unilateral actions have the potential to greatly impact other nations, both positively and negatively. India recently announced a ban on driverless cars on the road in order to protect jobs.[36] Due to this, researchers of autonomous vehicles may now looking to other nations, such as the United States or United Kingdom, who have recently approved public road trials of such vehicles.[37] Given that such research often creates many more spin-off developments, such as GPS, the Internet and touchscreens from military projects, it is possible that India may now face a more acute 'brain-drain' problem and miss out on key technological development milestones. Likewise, heavily regulating automation and AI research and development will neither halt its development elsewhere nor hinder scientists from traveling abroad to conduct their research in a more welcoming environment. Conversely, India's economy is heavily driven by the service industry, and banning automation in certain areas my give the government more time to decide what the best course of action is. When the world faced a similar conundrum over nuclear proliferation, the United Nations established the International Atomic Energy Agency that oversaw research projects related to nuclear activities. The Committee is able to recommend the establishment of a similar body, or add jurisdiction of an existing one, to oversee such research. The legal bounds and scope of such a body would be left to delegates to decide.

However, the creation of an international regulatory body presents its own set of challenges. From disagreement over its scope, concrete funding considerations and effectiveness, it faces similar challenges to the struggling World Trade Organization (WTO). Alternatively, bilateral or multilateral agreements could be negotiated outside of the structures of the United Nations. If this Committee recommended that nations engage in such an open negotiation under suggested terms, it is likely that many members would be willing to join.

A Stanford University report on AI policy poses three principle recommendations to avoid shortsighted policy implementations.[38] First, educating government officials, diplomats and high-ranking individuals about the nature of automation and AI is of primary importance, as they may refuse to permit or fund a promising research project or conversely, permit a project without sufficient vetting. Secondly, remove perceived and actual impediments to research on the fairness, security, privacy, and social impacts of AI systems. Finally, increase public and private funding for interdisciplinary studies regarding the societal impacts of automation. Aside from the first recommendation, the second and third are largely domestic legislation issues and without reform of the structure of the United Nations itself – which this Committee can recommend, but is likely to be not within the Committee's scope – this Committee is only able to offer recommendations as to how to achieve these. As such, short-term reform policies of the Committee are likely to be cautionary rather than concrete.

Long-Term Reform

The same Stanford University report also suggested that education reform and opportunities for continuing education are key in cushioning the arising unemployment issues.[39] This is a domestic policy issue and will increase prospects for individuals in the nation, seeing as educational attainment exhibits a strong negative relationship with the probability of computerization. While education and continuing education reform are welcomed suggestions, delegates should consider the implications this will have in the medium- to long-term.

A better-educated workforce may push large parts of the workforce abroad, if demand for low-skill jobs falls and supply of high-skill jobs remains stagnant. This could in turn place unexpected pressure on other nations as mass economic migration shifts the distribution of people around the world. One suggestion of MIT researchers was to allow better movement of people to foster better global entrepreneurship and job mobility,[40] and this could make mass economic migration problem even more acute. Whether this will push innovation in countries that have fallen behind in the automation revolution or place a burden on societies and systems is uncertain, as the world has not seen such a migration in recent times. Lessons could be learned from the agricultural and industrial revolution, but one should keep in mind that transportation and communication infrastructure was very different then as it is today. In the Organization for Economic Co-operation and Development (OECD) annual Secretary General's report, there is a brief mention of their work into future migration policy, most notably, the work they have done to better monitor worldwide migration.[41]

There may be a need to propose a negotiation on new series of trade deals, be that as part of the WTO or otherwise, to account for changes in global supply chains and manufacturing centers. Indeed, as the paradigm of offering labor for compensation comes under stress, an argument for a multilaterally agreed upon tariff on products made through automatic technologies can be brought in to compensate for and fund other policies that are implemented as a result of the automation economy across the world. One such policy may be a progressive tax system that taxes machinery, pollution or marginal top-level brackets over labor.

The Committee could suggest to the UN Conference on Trade and Development or to the WTO that trade negotiations be considered, or commission a body to further investigate how future developments will impact global trade and movement of people. Any action this Committee recommends must consider whether the world wishes to shift emphasis of from welfare of the productive process to the welfare of people and society.

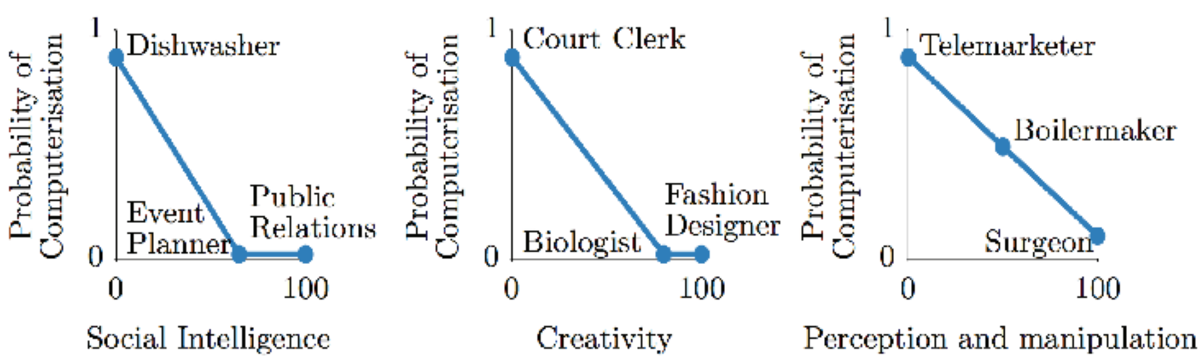


Figure 5. A sketch of how the probability of computerisation might vary as a function of variables that present challenges for AI researchers. (Source: The Future of Employment by the Oxford Martin Programme on Technology and Employment)

Indeed, from the Stanford University AI policy report to popular science books on the subject to even the 1964 Committee on the Triple Revolution, many suggest implementing a guaranteed basic income plan. While this remains a politically unpopular topic to approach, as the automation revolution marches on and the purchasing power of the average consumer falls – leading to the vicious cycle as discussed earlier – there may no alternative in avoiding what may become a tragedy of the commons problem, where the market of consumers (the common resource) becomes less and less without being replenished. This, combined with the potential for progressive tax reform in the long-term, may require a global coordinated effort: if left to states alone, there may be unintended migratory consequences or a widening of the gulf between developed and developing nations. The precise implementation of such a plan on a global scale will likely take several rounds of negotiations and, as the automation timeline remains uncertain, will likely take place as a reactionary measure. This Committee can decide to make pre-emptive suggestions in order to highlight the issues that will be associated with narrow AI automation.

However, general AI could also present challenges that extend far beyond contending with mass unemployment, from involved liability discussions to complete super-intelligence Armageddon. Currently, governments are not overly concerned with the challenges that general AI may face. The Obama Administration's Roadmap for AI Policy focused more on narrow AI rather than general AI for three reasons:[42] many experts believe that general AI is not feasible in the short or medium run; the authors assume the best way to prepare for general AI is to tackle risks from narrow AI, such as security, privacy, and safety; and the policy recommendations for general AI are unknown and may conflict with those for narrow AI, which is more certain and with immediate economic implications.

It is at the discretion of the Committee how discussion on general AI policy should proceed. Ultimately, it will likely be challenging to attempt to regulate research activity into general AI, given the benefits that such research may provide even if it does not produce a viable general AI. Open publication principles and data sharing are likely to be important first steps in ensuring that continued general AI research does not produce a potentially dangerous result. Researchers and regulatory bodies alike must foster civic and societal responsibility when tackling and implementing policy.

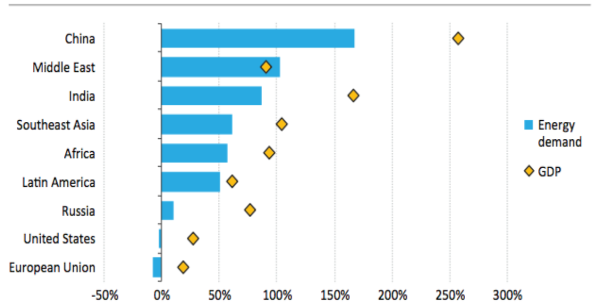
Automation and AI present great challenges for all human kind, yet if navigated correctly, the benefits could be unimaginable. This Committee's work is vitally important in identifying the major international challenges and leading the way forward for both domestic and international negotiations.

Energy and Energy Generation

In the run-up to the Yom Kippur war, the King of Saudi Arabia and the Egyptian President Anwar Sadat signed an accord where the Arab states agree to use the "Oil Weapon" as a pawn to influence the West during the military conflict.[43] Concurrently, US oil production was reaching an all-time low which had begun to place an upward pressure on oil prices and increasing reliance on foreign oil imports,[44] such as those from the Organization of Arab Petroleum Exporting Countries (OPEC). On October 6th 1973, Egypt and Syria begin attacks on Israeli-occupied lands, prompting Israel to go on full nuclear alert and President Kissinger being notified on the morning of October 9th, who promptly begins resupplying Israel with supplies and weapons. In response to this, OPEC raises the price per barrel by 70% and the next morning, OPEC announces a complete oil export embargo against the United States, United Kingdom, Netherlands, Canada and Japan.[45] As the short-term market for oil is inelastic – as a rise in oil prices will do little in the short term to curb energy or car use – the price per barrel skyrocketed, causing a price shock in an already unstable economy and leaving fuel pumps dry across the world.[46]

The 1973 OPEC Oil Embargo illustrates not only the geopolitical importance of energy control, but also how dependent we have become on energy. Sudden changes in supply can cause mass pandemonium and change the very way our day-to-day lives unfold. Thus, much like the International Atomic Energy Agency was created in response to the fears of nuclear proliferation and the potential resulting instability, the International Energy Agency was established in 1974 with "a broad mandate on energy security and other questions of energy policy co-operation among Member countries"[47] to coordinate major disruptions in the supply of oil. This mandate has broadened over the years to include promoting energy security, fostering economic development and championing environmental awareness for both member and non-member countries.[48]

Figure 6. Changes in GDP and energy demand in select



regions, 2000-2014. Increasing global energy demand means that sudden shocks in supply could have wider-reaching consequences than the 1973 oil embargo. (Source: World Energy Outlook)

Oil and other fossil fuels have defined the geopolitical landscape of distant and recent past. Before the rise of new generation methods like from renewable sources or nuclear fission, coal and later oil were the fuels that powered the development and industrialization of the West and to this day still form the basis upon which we have built our societies build. Indeed, we could still not launch a satellite without it. Regardless of the position one takes on climate change, there is an acute need to begin transitioning away from old sources of energy to new, sustainable sources that will power the development of the global society through the next revolutions and advancements. This need will be satisfied with new energy sources, be that unconventional oil, renewables or nuclear fusion. Delegates should refrain from discussing the climatological impacts of continued "business as usual" energy generation, as the UN Framework Convention on Climate Change Paris 2015 agreement has settled the issue, but instead focus on how to foster the evolution of new generation technologies and whether this change will have other impacts on the international community.

This guide will not contain an exhaustive list of discussion points. Given the breadth of this topic, the guide is meant to guide delegates' thinking about the topic, and to promote further research. Future energy generation and its associated considerations may have hugely varying consequences on different regions and countries, and it will be in the best interest of delegates to prepare themselves for committee by considering other facets and solutions not covered in the guide.

The importance of energy cannot be understated. It is what creates the comfort and abundance that much of the world benefits from, and limited access to it is in part what creates challenges in developing nations. Business surveys point to around thirty electrical outages per month in Nigeria and the Central African Republic, resulting in economies unable to reach their full potential.[49] Thus, controlling access to energy means wielding influence, and it will be at the hands of delegates to decide how they wish to build a framework that allows for the continued use of energy as a medium to power for a few nations, or whether with the introduction of new technologies to democratise it.

Steps have already been made towards the democratisation of energy and the transition away from polluting sources through the Intended

Nationally Determined Contributions (INDCs) as set out in the Paris Agreement.[50] Article 10.4 further establishes a "technology framework" that promotes technology development and transfers to "fully realize the technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions."[51] These provisions are a breakthrough in international cooperation and are vital in ensuring that the global temperatures do not rise to dangerous levels, but the Paris Agreement does not set out a framework for this transfer or consider other possible consequences of continued development.

However, in parallel with this agreement, traditional oil producers like OPEC and newly the United States have been investing in exploiting unconventional oil reserves, which has created an entirely new oil supply that has the potential to delay peak oil by a significant amount of time.[52] Due to the sudden flood of unconventional oil onto the global market in 2014 by the United States, OPEC refuses to cut production to regulate prices as traditional market wisdom might suggest, forcing the price per barrel down from over US$50 to US$30 – a price at which unconventional oil reserves cannot be easily exploited. This has resulted in 75% of America's drilling rigs being mothballed.[53] Fears of trade embargos against Venezuela and its easily accessible oil fields have also caused concern about supply shortages, especially given the uncertainties surrounding extraction of oil from alternate sources.[54] These examples illustrate how even following the 1973 oil crisis and Paris Agreement, and despite the increase in renewable energy sources, energy still plays a vital role in the global geopolitical landscape.

UNFCCC Party	Intended Nationally Determined Contribution (INDC)
China	Peak GHG emissions by 2030 or earlier and reduce carbon intensity of GDP by 60-65% below their 2005 levels by 2030.
United States	Reduce net GHG emissions by 26-28% below 2005 levels by 2025.
European Union	Reduce EU domestic GHG emissions by at least 40% below 1990 levels by 2030.
India	Reduce the emissions intensity of GDP by 33-35% below 2005 levels by 2030.
Russia	Reduce anthropogenic GHG emissions by 25-30% below 1990 levels by 2030 subject to the maximum possible account of absorptive capacity of forests.
Japan	Reduce energy-related CO_2 emissions by 25%, reduce non-energy CO_2 emissions by 6.7%, CH_4 by 12.3%, N_2O by 6.1%, and fluorinated gases by 25.1% compared with 2013 levels by 2030.
Korea	Reduce GHG emissions by 37% by 2030 compared with a business-as-usual scenario.
Canada	Reduce GHG emissions by 30% below 2005 levels by 2030.
Brazil	Reduce GHG emissions by 37% compared with 2005 levels by 2025.
Mexico	Reduce GHG and short-lived climate pollutant emissions unconditionally by 25% by 2030 with respect to a business-as-usual scenario.

Figure 7. Emission reduction goals in submitted INDCs for top-ten carbon emitters as of 2015. (Source: World Energy Outlook 2016)

Energy Production

Energy comes in many different forms, the most end-user forms common being stored in fuels and transmitted to our homes as electricity. Both fuels and electricity have geographical and resource limitations that have dictated where and when they can be produced, irrespective of the economic pressures that global economies have imposed. The raw material for fuel has traditionally been carbon-based fossilized remains beneath the surface that over millions of years have been transformed by heat and pressure to form the raw materials for fuel. These materials are commonly extracted from the ground from its reservoir through one of several methods depending on the type of oil and geology of the reservoir. Broadly speaking, there are two categories: conventional and unconventional extraction. Conventional extraction involves using the internal pressure from the reservoir – typically a large pool – to push the raw material to the surface. Unconventional extraction requires large quantities of liquid or steam to be pumped into the reservoir – which is not necessarily a simple pool – to force the raw material to the surface. The most common method of unconventional oil and gas extraction is hydraulic fracturing – often termed fracking. High-pressure water mixed with other chemicals and sands is forced into small fissures underground, releasing oil and methane that was previously trapped in small pores within impermeable rock. It is estimated that these techniques have offered fuel security to the US and Canada for about 100 years.[55]

Given the INDCs that nations have submitted as part of the Paris Agreement, and given that fossil fuels are a limited resource, there is a need to transition to alternative and sustainable sources of energy, regardless of the proliferation of unconventional extraction techniques. The IEA's World Energy Outlook 2016 reports under their 'new policies scenario' how different regions are intending to bolster their renewable resources: California committed to a 50% renewable portfolio standard by 2030; the European Union is aiming for a minimum requirement of 27% renewable energy use by 2030 and China intends to build 200 GW of wind power and 100 GW of solar PV by 2020 according to their INDC.

These new clean energy sources can range from renewable sources to nuclear fusion, all of which have their own technological, political and environmental problems. Additionally, electric vehicle ownership is projected to increase, meaning that as the world transitions away from petroleum and diesel-powered vehicles, the supply of electricity will not only need to match that of increased electric vehicles on the road, but also the increased demand from nations that are progressing along the development pathway.

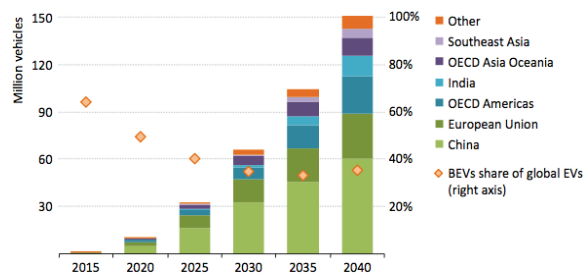


Figure 8. Electric vehicles in circulation under current national policies. (Source: World Energy Outlook 2016)

Electricity is conventionally generated through combustion of fossil fuels like coal to produce heat. This heat is used to create high-pressure steam that is then fed into a turbine to convert the energy stored in the steam to rotational kinetic energy. The output of the turbine is geared and connected to a generator, in which the kinetic energy of the turbine is converted to electricity by spinning large magnets through copper wires, which creates a voltage difference that allows current to flow. These generators are synchronised to the alternate current (AC) frequency of the power grid before they are connected to avoid short-circuiting the generator.

Renewable power generation works on the same principle of conservation of energy, converting from one type of energy – like thermal, mechanical or chemical – to electricity. The effectiveness of each type of generation method depends very heavily on the location of the installation, as each one is dependent on renewable natural phenomena. David McKay's *Renewable Energy – Without Hot Air*, while slightly outdated, provides a thorough estimation of the United Kingdom's energy consumption and provides a mathematical framework by which to understand the volume of renewable resources required, given the strengths and weaknesses of each type.[56] The five primary types of renewables are as follows:

Solar: Solar energy refers to two types of energy capture. Solar thermal is used primarily in in residential and industrial settings to provide heating and hot water using solar radiation.[57] The more commonly referred to type of solar energy is photovoltaic generation, which generates direct current (DC) electricity through photons striking the semi-conductor material in the photovoltaic cell, freeing electrons and creating a voltage.[58]

Wind: Wind generation is conceptually simple to understand, as it simply consists of a generator that, through a series of gears and control systems, is connected to the rotating shaft from the blades that ensure the generator is running at the synchronous frequency of the power grid.

Geothermal: The inside of the Earth contains molten rock and iron at astronomically high temperatures, as evidenced through volcanic eruptions. In geothermally active areas of the world, such as Iceland and Hawaii, it is possible to drill down and pump water into the Earth. The water is heated and transformed to steam, which emerges from the Earth at high enough pressure to run a generation turbine.

Biomass: biomass energy is produced from organic material such as plants, wood and food waste. This is converted to energy by combustion to produce heat or by converting them into methane, ethanol and biodiesel fuels, which can be translated more easily into our current methods of energy use. As they are often grown on farmland, biofuels are carbon neutral, but can place additional burden on food supply chains.

Hydrological: energy can be generated through the natural movement of water, be that through damming of rivers or placing tidal generation plants across estuaries, like the United Kingdom's Severn Estuary generation facility. Water flows through generators that are geared to be rotating at the synchronous power grid frequency.

Nuclear power has always been a subject of controversy. Germany's *Energiewende* – the transition to a low carbon, environmentally friendly and affordable energy supply following the Fukushima disaster in 2010 – promised to remove all nuclear generation capacity from Germany, while France and the United Kingdom have committed to cooperating to build infrastructure and expertise in nuclear energy.[59] The relative merits of whether nuclear energy is the right way forward – factoring in decisions like risk, access to fissile material and geopolitical restrictions – for a nation is not within the scope of this guide; however, nuclear fusion generation is certainly within the scope of this committee, as it has the potential to radically revolutionize the energy markets across the globe.

Current nuclear energy generation is achieved through nuclear fission: the splitting of a heavy atom of an element to release the energy in the atomic bonds to produce heat that is able to drive a generator. In what could be described as one of nature's most fascinating phenomena, a slow-traveling neutron – a neutrally charged subatomic particle – collides with an atom of Uranium-235, which makes the atom unstable. The U-235 then splits to form an atom of Barium, Krypton and three other neutrons. Through clever engineering in the nuclear reactor, these neutrons are then used to split further U-235 atoms, creating a stable chain reaction.[60] Incidentally, not moderating this reaction is how an atomic bomb creates the runaway reaction. Nuclear fission produces huge amounts of energy without the production of traditional harmful pollutants, but does produce radioactive waste that cannot be used in a reactor but remains dangerous for many years.

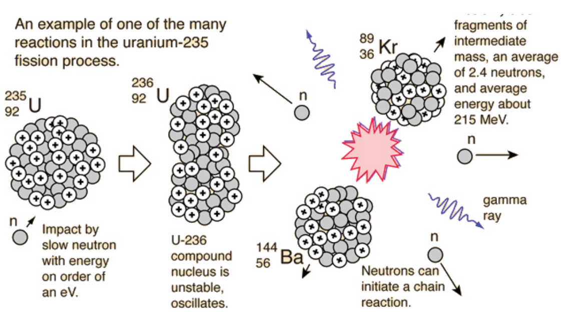


Figure 9. Uranium-235 is split into an atom of Krypton and Barium through the addition of a neutron, creating a chain reaction in the fissile material. (Source: Hyperphysics)

The other type of nuclear power generation is termed nuclear fusion. This is the process that our sun uses to create energy and is the process that releases the energy stored inside a hydrogen bomb. In a typical fusion reaction, two isotopes of hydrogen, one of which is rarely found in nature, but is readily produced with a reaction involving lithium. These isotopes are forced together to form helium and through this fusion, very large amounts of energy are released – approximately six times the amount per reaction as compared to fission reactions[61]. Fusion has several advantages over fission, including reduced radioactivity, ample fuel supplies, and increased safety. However, fusion reactions have a very high initial energy requirement to begin reacting: when an atom is heated above its ionization energy, its electrons are stripped away, leaving the positive charged nucleus. The resulting plasma is electrically conductive and magnetically controllable, which most fusion reactors take advantage of to control the particles. Similar to a fission reactor, most proposed designs work on a chain reaction principle to evolve heat and thus create a net output of energy. Other designs use lasers to heat a small pellet of the fuel to the requisite temperature. As of 2017, no design has produced a net positive energy output.[62]

In 1957, the International Atomic Energy Agency (IAEA) was created in response to the fears generated by the discoveries and diverse uses of nuclear technology under the auspices of the United Nations and has the task "to promote and control the Atom" for its contributions to peace, health and prosperity.[63] In 1970, the IAEA created an advisory body, the International Fusion Research Council, which oversees and fosters research into specifically fusion generation and were pivotal in creating the International Thermonuclear Experimental Reactor (ITER) project. ITER was first suggested by the Soviet Union and is one of the first large international research collaborations to demonstrate the feasibility of fusion power, and in 2007 the ITER Agreement came into force.[64] However, the reactor was to have switched on in 2016 and cost around €5bn, its price has since roughly quadrupled and its start-up pushed back to 2025. Full-scale experiments are now not foreseen until at least 2035.[65]

There are two things that must be considered here. First, given the promising nature of fusion generation, a loss of political support that may, according to an ITER nuclear engineering manager, "run the risk of delaying fusion electricity well into the 22nd century" may be a loss that we are unable to afford if we want to guarantee global energy security.[66] Secondly, the ITER project is a collaboration of six nations and EURATOM, part of the European Union. Unlike in the 2015 Paris Climate Agreement, there is no specific provision in the ITER agreement that states that these parties are required to share their findings. Thus, although unlikely, there exists the possibility that the findings from ITER do not result in a better global understanding of fusion and subsequent proliferation of nuclear fusion generation, but rather a concentrated few nations that may one day be able to produce power at orders of magnitude cheaper cost. Indeed, the United Kingdom is currently negotiating with the European Union to remain part of EURATOM in Brexit negotiations, as the United Kingdom is interested in fusion research.[67] Failure to remain part of EURATOM would put the United Kingdom in the same position as the vast majority of the world's other nations – with uncertain access to the research results achieved at ITER.

Figure 10. The United Kingdom National Grid control center. The United Kingdom's power flow is controlled and predicted here , with generators instructed to go online or offline depending on current national demand. Power can also be bought and sold from Norway and France. (Source: Financial Times UK)

Nuclear fusion presents one of the most ambitious yet promising generation methods for near-infinite clean energy, given the abundance of the fuel source required and the sheer amount of energy that is released through fusion of two atoms. However, a nuclear power reactor cannot be easily taken offline or have its output moderated. Thus, much like coal power plans currently, they form the 'base load' of a national power supply grid – a generation source that is always online and has only very little need to be moderated. On national grids, power generation needs to precisely match power demand. The UK National Grid system operator has a contract from the government regulator that requires them to keep the system within ±1% of the nominal frequency 50Hz (60Hz in other parts of the world). If there is more supply than demand, the frequency will increase and it will decrease if there is more demand than supply. Either situation causes grid instability and may result in certain zones having their power cut to restore stability to the system. This balance is maintained by careful predictions of several factors, including the outside temperature, the time of an important sports match and whether it is a national holiday. While people's behaviour changes with these factors, generation capacity required to meet the dynamic demands on the grid traditionally has not; however, with renewable sources now being the second largest source of electricity globally,[68] and as the number of homes with renewable generation capacity continues to grow, grid managers will need to not only take into account our behaviour, but also how generation capacity needs to dynamically adapt to a more variable grid network.[69]

Nations are developing 'smart grids' under a set of common international standards that are profoundly changing the way that energy is being managed. As a report from the World Resources Institute that looks at future grid considerations in developing nations concludes, "the electricity sector is undergoing a transformation, transitioning from a sector that is statically planned and operated by central authorities, to one that is increasingly driven by a mix of variable technologies, decentralized operators, and new market mechanisms and ownership models."[70] This decentralization will make it easier for previously unconnected communities to receive power as well as stabilizing the inadequate infrastructure that many developed nations rely on. As part of this infrastructure, grid-level energy storage solutions will be necessary, but few current solutions are capable of meeting the long lifetime, low-cost and high-power demands of the grid, although progress has been made.[71]

There are three main components of a battery: two terminals made of different chemicals, the anode and the cathode; and the conductive electrolyte, which separates these terminals. When the battery is being discharged, electrons flow from the positive anode to the negative cathode terminal in a reduction reaction, while ions in the electrolyte flow the other way around in an oxidation reaction. In rechargeable batteries, applying a negative voltage to the anode reverses these two reactions, but repeated charge-discharge cycles will wear the battery down.

Given the chemistry of batteries, the compounds chosen for the electrodes are likely to contain some rare earth or alkali metal like Lithium. Lithium, although the 25th most abundant element in the Earth's crust by mass, according to the Handbook of Lithium and Natural Calcium, lithium is a comparatively rare element, as it is always found in very low concentrations.[72] As lithium is a finite and uncommon resource, and likely to be in very high demand due to modern grid load management technologies, the increasing population of electric vehicles, the potential for lithium to be used as a fuel in fusion reactors and the already high demand for small rechargeable batteries – which are lithium-based currently – lithium reserves could become extraordinarily geopolitically important.

Figure 11. The lithium triangle in South America contains over 54% of global lithium reserves and has been largely untapped. (Source: The Economist)

Only seven nations have significant lithium reserves, and of those seven, three – Argentina, Chile and Bolivia – control 54% of the world's lithium resources in a region called 'The Lithium Triangle' (see map). China and the United States collectively control 30%.[73] While the South American reserves have been left largely unexploited due to lack of investor confidence in Argentina and Bolivia, annual contract prices for lithium carbonate and lithium hydroxide doubled in 2017, indicating a growing shortage of supply and the potential for these seven nations to one day wield their 'white gold' lithium reserves in the same way OPEC did in 1973.

Similar parallels can be drawn with other resources. Gold, platinum and other rare earth metals are resources required to manufacture a variety of renewable energy commentary devices. Platinum is used extensively in hydrogen fuel cells and catalytic converters, and rare earth metals in photovoltaic cells. Helium is also a finite resource, although not often considered one, and if not stored in natural reservoirs, leaks out of Earth's atmosphere. Helium is used to create superconducting magnets that are used in experimental fusion reactors and medical scanners. Following Germany's *Energiewende*, the German government published a report that analyzed the possible future limitations on renewable generation implementation in Germany given the scarcity of some minerals.[74] It concludes that "specific elements of wind energy, photovoltaics and battery storage are identified as being critical with regard to the supply of minerals". With the understanding that all nations will one day need to transition to renewable sources, or at least use renewable sources through the potential transition to a predominantly fusion-based energy grid, there is an acute need to begin discussions surrounding the raw materials themselves.

Reform

Energy policy is a monumental topic area that has been the subject of discussion in several committees and summits. Indeed, it is not hard to imagine this topic overwhelming the Special Summit on Futuristic Technologies if discussion is not kept focused on the mandate of this committee: to identify and begin proposing solutions to the problems raised by current technologies and their future developments, rather than to debate the threats of climate change or the effectiveness of the Paris Climate Agreement. Delegates are encouraged to work within the framework of existing agreements and the INDCs as determined by their governments to identify future hazards and establish pre-emptive solutions according to the priorities of their nation, be that access to renewable energy, technology sharing, energy security, mineral scarcity or securing the future of nuclear fusion generation. Solutions to the issues raised by the committee must be rooted in collective self-interest and practical action.

Short-Term Reform

For the immediate future, the Paris Agreement in Article 10 indicates a desire for a technology framework. However, as of late 2017, it is still unclear how the technology framework will be implemented or how long it will take to iron out the details aside from using the already established Technology Mechanism, created in the UNFCCC 2010 Conference of the Parties. Similarly, the carbon market mechanisms that Article 6 proposes are "not enough to ensure that a new tradable commodity emerges", according to a study from the Centre for European Policy Studies.[75] Further, with the rise of the prevalence of unconventional oil extraction and persistent fossil fuel subsidies in some nations, incentives to implement appropriate pricing for non-renewable energy sources are confused by short-term market forces pushing energy sector development in a counterproductive direction, both in terms of climate and energy security for the future. These developments are indicative of the fact that short-term risk management and mitigation in the energy sector is monumentally challenging.

An internationally agreed carbon markets and universal carbon pricing need to be created in a multilateral setting to be workable and would likely realign domestic market incentives. Nevertheless, despite this, the Paris Agreement Article 6 is a "minor miracle" and thus this committee should not seek to modify it.[76] Fostering of research and development into renewable generation and nuclear power generation technologies should be a key short-term policy goal given the international legislation surrounding the topic of energy already. This must be understood with emphasis on the fact that nuclear fusion has yet to demonstrate a net energy output and thus puts into question whether fusion will ever be able to be a useful energy source. Focusing investment into renewable sources and extending the Technology Mechanism to include nuclear technologies are potential solutions, but need to be considered with, amongst other things, national security and scientific feasibility.

Identification and management of key raw mineral and compound reserves across the globe may also be a concern for the committee to address. As discussed above, lithium stands to make a handful of nations, that numbers fewer than those currently with access to oil, very important players in a future potentially battery-powered grid. Delegates will have to decide how this distribution will affect geopolitical balances and how to best prepare for them. Requiring nations to provide access to their own resources is currently not possible without that nation's consent, but measures could be put in place to regulate the global market price of such resources to prevent another event like the 1973 oil crisis. However, such a measure would require significant international support, as manipulation and regulation of the open market may set a dangerous prescient. The Committee could suggest implementation of a recycling program under the Paris Agreement framework in the form of INDCs as a certain percentage of, for example, lithium or other resources that is used is recycled and either used domestically or sold internationally.

Long-Term Reform

There will be two scenarios that delegates will need to consider when drafting a resolution. The first is assuming that nuclear fusion becomes a net positive grid contributor and the second is assuming that nuclear fusion energy is not demonstrated to produce adequate net positive output to the grid.

In the first scenario, it will become very likely that nations that are able to afford the reactor construction and have the requisite expertise will be able to produce near-infinite amounts of energy for remarkably little cost. This has the potential to split the world between nations that have effectively free access to energy and those that do not. Already this is the case with regards to nuclear fission generation, as illustrated by the controversial 2015 Iran Nuclear Deal negotiations in which the Iranian government stressed that peaceful everyone has the right to nuclear energy.[77] With fusion, the stakes could be significantly higher as much more energy can be produced, but practical knowledge of fusion reactors could make it easier for nations to develop a hydrogen bomb warhead. The extent to which research and knowledge should be shared with nations not part of the ITER agreement will need to be considered by delegates.

In the second scenario, the world will need to come to terms with the fact that energy will be much harder to generate. Indeed, as fossil fuel reserves begin to dry up or become economically unfeasible to extract, there could be a rush for resources that create geopolitical imbalances and energy uncertainly within many nations, as discussed above. However, renewable energy generation technology is less controversial to share, and several groups have already committed to helping developed nations with regards to renewable generation. For example, the G7 have committed to accelerating "access to renewable energy in Africa and developing countries in other regions with a view to reducing energy poverty".[78] The Technology Mechanism provides a good voluntary framework for this, but delegates will need to decide whether acting in solely in the spirit of goodwill in sharing technology is a reliable thing to potentially depend on.

Other areas delegates are encouraged to potentially explore are the technical complications of a renewable system. Due to the volatile nature of renewable generation, there may be a need to further connect national grid networks across borders to better handle energy fluctuations. Europe is working towards greater connectivity,[79] achievable because the region operates on the same 220V/50Hz frequency. In areas like South America, the Middle- and Far-East, national standards differ more widely, from 220V/50Hz in Argentina to 127V/60Hz in Brazil. However, the benefits of a unified grid may not outweigh the cost of transitioning to a new standard, which could involve changing physical installations in every city and home.

Energy is a large and complicated topic, and this guide only touches briefly upon the multiple facets that could be debated. Delegates are encouraged to think carefully about how future energy developments may affect their country to prepare for debate and create initial solutions accordingly.

Biological Research and Biotechnology

In light of the then recent development of a DNA modification method that produced so-called 'recombinant DNA' molecules in 1975, the chief researcher from Stanford University organized a conference at Alisomar State Beach that brought together biologists, ethicists and lawyers to discuss the potential biohazards that could arise from widespread and unregulated adoption of this new technology.[80] The conference established two fundamental principles that govern how experiments are conducted. The first principle for dealing with potential risks was that containment should be made an essential consideration in the experimental design. The second principle was that the effectiveness of the containment should match the estimated risk as closely as possible. For this, four levels of risk were established, each with its own set of rules. [81]

The Alisomar Conference on Recombinant DNA as it came to be called, proved to be a pivotal moment in the development of biological research and its effects are still being felt to this day. However, with the recent development of new DNA modification techniques and their rapid development in the scientific community, there now exists the potential to conduct more ambitious experiments. These could range from editing the genome of human embryos to prevent hereditary diseases, to engineering the crops we eat to ensure that the world will have enough to eat well into the future with a ballooning global population.

However, as with almost all revolutionary scientific developments, the technology can be used to further ulterior motives. This risk is much more acute with biological developments: the potential to irreversibly damage ecosystems, change human characteristics and create silent yet deadly weapons of mass destruction cannot be taken lightly, or the world may mirror that envisioned by Aldous Huxley in his *Brave New World*, where modification of embryos to ensure an unquestioning society.

DNA Manipulation

DNA, or deoxyribonucleic acid, is a long-chain polymer molecule. Rather than consisting of a finite number of atoms, a polymer molecule consists of several repeating units of atoms called monomers. DNA forms a double helix structure 'backbone' to which four different chemical structures are able to connect to. These are called bases or letters: adenine (A), guanine (G), cytosine (C), and thymine (T). DNA bases pair up with each other, A with T and C with G, to form units called base pairs, which look like rungs of a ladder on the double helix phosphate backbone.[82]

In eukaryotic cells – often animal and plant calls – DNA molecules are organized into chromosomes that consist of two halves. Humans have 23 pairs of chromosomes, with one of each pair coming from each parent. This number varies wildly between eukaryotic organisms depending on the complexity and size. The chromosomes are located in the nucleus of the cell. DNA is also found in the mitochondria of eukaryotic cells. In prokaryotic cells – simple organisms like bacteria – the DNA is carried on singular circular loops of DNA, called plasmids.[83]

DNA is often referred to as the 'code of life', but what is the actual meaning of this? In living organisms, most of the chemistry that creates life at a cellular level is caused by the interaction of proteins with other substances or proteins. A protein is simply a chemical term for any polymer that consists of amino acid monomers.[84] There are twenty different naturally occurring amino acids. These amino acid monomers that form proteins can fold into a unique 3D structure as defined by the chemical composition of the protein.[85] This molecule is able to catalyze reactions that would otherwise not happen. At a simple level, DNA encodes for these proteins. In the strand

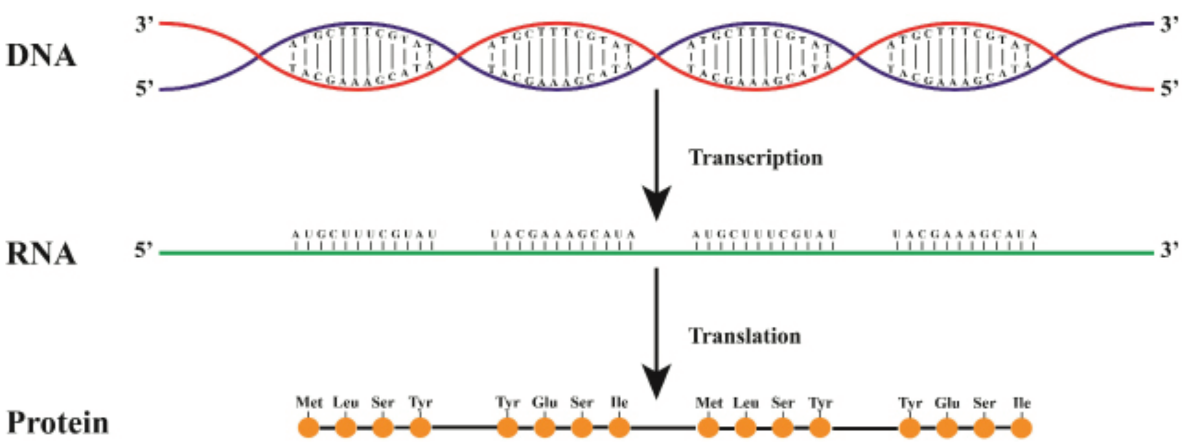


Figure 13. DNA is transcribed to mRNA and Ribosomes use this mRNA template to synthesize proteins. (Source: science-explained.com)

of bases, each group of three letters – called a codon – codes for a different amino acid.[86] A series of codons that code for a protein is called a gene. Transcription enzymes read the strand of DNA and produce a molecule called messenger ribonucleic acid (mRNA), which exits the nucleus. Ribosomes in the cell then use the mRNA as a template to synthesize the amino acid chain and form a protein.

Through the complex interactions between different proteins, different traits can emerge, ranging from eye color, to whether the organism glows in the dark, to the nutritional content of a fruit. Biologists have identified many parts of different genomes (the term given to the collection of all DNA of an organism) that code for specific traits. Thus, through modification of different parts of the genome that encode for specific proteins, biologists are able to change the 3D structure of the encoded protein, which changes how it chemically interacts with the rest of the body, and can ultimately change the resultant characteristics of an organism.

Up until recently, and the inspiration for the Asilomar Conference, the main method of editing a genome was through the creation and introduction of recombinant DNA, or rDNA. In this protocol, scientists identify the gene of interest, use a restriction enzyme to cut it out of the donor organism's DNA and use a polymerase chain reaction to create many copies of this gene. The gene is then added to a vector – the name given to the method by which the gene is delivered into the host organism, often plasmids – and using a DNA ligase enzyme, the vector plasmid loop is closed, containing the foreign DNA.[87] This plasmid is then inserted into a host cell, which is allowed to grow in favorable conditions to create many copies. Biologists will often include other DNA markers to more easily see whether the host has accepted the foreign DNA, like green florescent protein, which makes the cell glow in the dark. While powerful, this method suffers from some drawbacks, most notably that it requires a quite involved series of steps and can thus often be a very imprecise tool. Indeed, the method is not particularly effective with eukaryotic cells, like animals and plants, and it is not possible to change an entire organism's genome unless the embryo is modified after fertilization.[88]

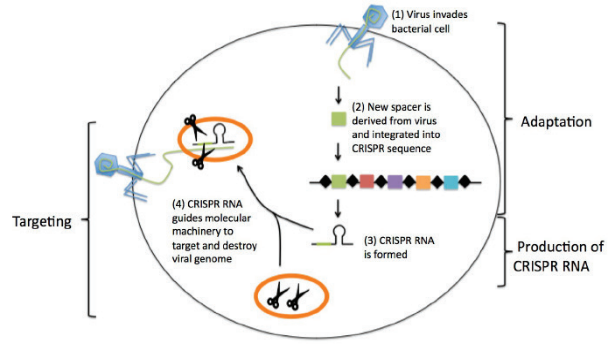


Figure 14. The steps of CRISPR-mediated immunity. (Source: PubMed)

However, very recent research has produced breakthroughs in a new category of gene manipulation techniques called CRISPR/Cas9. CRISPR (Clustered Regularly Interspaced Short Palindromic Repeat) refers to short, partially palindromic repeated DNA sequences found in the genomes of bacteria and other microorganisms such as eukaryotic cells.[89] These contain 'spacers' that are DNA sequences derived from previous viruses that have tried to infect the cell. The CRISPR immune system of the cell will produce guide RNA (gRNA) from this sequence if the infection were to ever happen again. The gRNA associates with and guides bacterial molecular machinery to a matching target sequence in the invading virus and destroys the invading viral genome.[90]

The 'seek and destroy' function of this CRISPR system is executed by the Cas9 protein (CRISPR-associated system). However, by providing a synthetic version of the gRNA, biologists can leverage this function of the Cas9 protein to cut a strand of DNA at a very specific location in the genome to either silence a gene or add DNA to the location by providing an additional repair template. In this way, the CRISPR/Cas9 technique opens the door to previously unimaginable DNA modifications, especially seeing as the system works on living cells within a larger organism and can be delivered via a viral vector. This theoretically means that the genome of larger organisms can be modified without the need to birth a new one.

Implications of Advanced Genome Manipulation Techniques

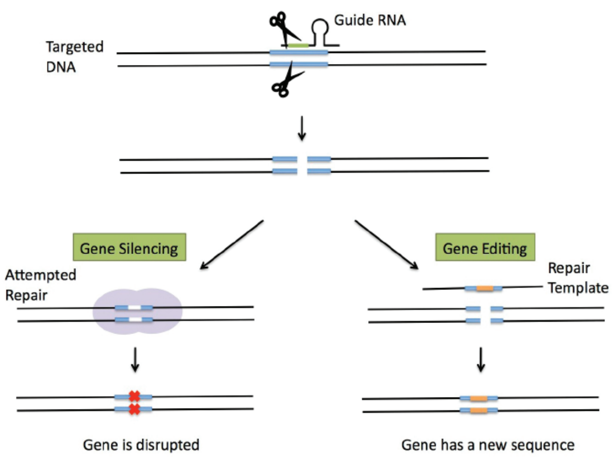


Figure 15. Gene silencing and editing with CRISPR. (Source: PubMed)

CRISPR has now advanced to the point where it is no longer just a high-end and overly complex tool that only universities and private laboratories are able to afford. Consumers can now purchase a US$150 kit for their own personal projects at home or in high-school labs.[91] The democratization of this technology has not only made it easier for people at earlier stages to get involved in biological research, but has allowed the current research to progress at a rate much faster than expected. Given this, there is a pressing need to consider the future impacts of applications of biological editing and create a framework for future discussion. Delegates are encouraged not to fall into the rhetoric of current chemical warfare and often scientifically inaccurate speculatory articles, but to focus their discussion around identifying key emergent multi-national concerns as DNA manipulation technologies further mature.

Human embryo editing is an example of such a consideration. A recent publication in *Nature* – a well reputed scientific journal – demonstrated that it was possible to correct a mutation in a gene called MYBPC3 that causes a deadly familial heart condition known as hypertrophic cardiomyopathy.[92] Researchers fertilized several eggs and screened them for the mutation, and found that as compared to the control group, a higher percentage of the zygotes contained the healthy version of the gene. Interestingly, however, researchers also pointed out that their genetic markers were not present in the healthy zygotes from the template DNA, indicating that the cell seemed to have repaired itself using the other healthy copy of the gene from the other parent rather than by using the template DNA provided. This revealed a repair mechanism that was previously unknown, and simultaneously raised the question as to whether zygotes will resist other modifications.[93] This discovery puts the headlines that immediately jump to the conclusion that designer babies (where parents are able to select traits in their offspring before the egg is implanted) are imminent. Rather, much more research is required.

Regardless of feasibility currently, the fact that healthy zygotes were produced is remarkable. Repairing genes early in life could generate huge savings for society and the medical systems, as well as increasing quality of life across the globe. Conversely, given the growing uncertainty surrounding intellectual property rights associated with genetic information, it is uncertain as to whether research results, especially by private enterprises, will be shared with equal access. At the extreme level, if 'designer babies' became possible, developed nations with access to the technology would be leaps and bounds ahead of their developing counterparts just in terms of the intellect and physical well-being of their respective societies, given that they are likely to design to better those qualities. Indeed, a Chinese university have already modified human genes and injected them into a cancer patient with positive results.[94] The European Union's convention on human rights and biomedicine says tampering with the gene pool would be a crime against "human dignity" and human rights, but this declaration was made before it was feasible to precisely engineer DNA,[95] but given the ease of doing so, modifying just a handful human genes to confer extraordinary qualities or resistance to disease, like making your bones so hard they'll break a surgical drill or cutting the risk of heart attacks, seems like an inevitability. Indeed, The CEO of OVAScience predicted that functional eggs were "a when, and not an if".[96]

Aside from human genome editing, advances in other areas have also been made, most notably in the area of virology. The deadly avian flu virus H5N1, which was previously very rarely transmitted between mammals, was recently engineered by two separate laboratories to more easily able to jump between mammals.[97] After receiving pleas from the scientific community to redact the paper, the journal *Nature* refrained from publishing it for sixty days to allow for a discussion to take place surrounding whether publication was ultimately more beneficial to further scientific understanding over making potentially globally-threatening information public.[98] The leading researcher emphasized that the benefits of conducting and fully publishing this work outweigh the perceived risks, arguing that scientific research often lead to unexpected discoveries, such as the case with nuclear power emerging from the Manhattan Project or CRISPR/Cas9 emerging from research into cell immune system mechanisms.

However, as DNA manipulation becomes more and more accessible, it is not outside the realm of possibility to imagine how a state or non-state actor may use such information to attempt acts of bio-terrorism. As there is currently no unified body that oversees global biological research in a similar way to how the IAEA oversees nuclear energy research, it is challenging to even begin to assess the risks that the world faces from potential bio-terrorists or indeed accidental release of deadly biological material due to non-standard approval and laboratory procedures.

Similar to how researchers are now able to modify viruses and bacteria to have specified traits, they also have been able to modify crops at the genetic level to exhibit desired traits. Delegates are encouraged not to focus on the perceived issues of engineered crop consumption – indeed after a decade of research into the health effects of such crops, there is no evidence that they are in anyway unsafe for human consumption –[99] but rather to consider the wider global impacts if they were to be more widely implemented.

A UN estimate stated that we would need 70% more food by 2050.[100] Aside from using more land than we currently do to grow more food, agriculture will need to intensify in order to keep up with population growth, sustainably feed said population, and simultaneously not cause irreversible damage to the natural environment through overuse of pesticides and herbicides. Tomatoes that grow larger with higher levels of antioxidants, or rice with higher levels of vitamin A could be grown with further genetic modifications that make them drought and flood resistant, or herbicide resistant.[101] These changes would make the plant more resilient to an already changing climate. However, the divide between nations with the resources to conduct this modification by themselves and those that are not presents challenges. Concerns are easily raised with regards to shifting demand for agricultural imports, changing allocations of subsidies and even intellectual property rights, as these enhanced crops are likely to be developed by private rather than state enterprises.

It is the task of the delegates and the committee at large to establish to what extent and whether these concerns need to be addressed. Delegates should also note that the discussion above is not intended to be an exhaustive list. DNA manipulation and its consequences may have an impact far greater than imagined, and it is the task of this committee at large to create a framework within which identified issues can be discussed. An attempt to resolve all the policy complications that biotechnology will present will likely result in unproductive and repetitive discussion, rather than insightful negotiation.

Reform

Biotechnology has the potential to revolutionize the way in which we interact with and manipulate the world we live in, from providing enough food to feed everyone on the planet to curing previously incurable diseases. Indeed, other more novel applications are also possible: in the summer of 2017, researchers announced that they had successfully encoded an animated GIF into a strand of DNA using the CRISPR/Cas9 system.[102] They decoded the file using modern nanopore sequencing techniques.[103] This novel use of a biological system to encode digital data could encourage other researchers to peruse other projects. For example, a cell could "encode information about what's going on in the cell and what's going on in the cell environment by writing that information into their own genome", according to one researcher on the GIF project.[104]

Suggesting policy measures to pre-emptively tackle some of the big questions presented will naturally be slightly vague, but should be informed by sound scientific principles and a reasonable understanding of how such policy should be implemented over time as the technology evolves. Policy that this committee recommends should ultimately consider both the implication for the scientific community as well as the socio-political impacts at a multilateral level.

A common concern amongst scientists and researchers is the widely varying ethical and safety standards across both state and private research institutes. Indeed, while western nations like those in the EU and the United States often have lengthy approval processes and engage in much debate about the ethics of the research, other nations may be more permissive. China has already announced (as of April 2017) seven state-funded Crispr/Cas9 trials in humans using the procedure,[105] and a mitochondrial transfer procedure – involving the transfer of DNA-bearing structures between eggs – was conducted New York fertility doctor in Mexico.[106] Conversely, in the United States, the National Institute of Health does not fund research on human embryos and the U.S. Congress has forbidden the FDA from approving any state-funded clinical trials.[107] Thus any research in countries with similar laws needs to be privately funded, which potentially places them at a disadvantage when competing on the international stage, or indeed in benefiting from the advantages such research may provide society.

Much like other technologies that are considered dangerous, like nuclear weapons and current chemical weapons, are monitored by a complex combination of technical bodies, international diplomacy, sanctions, and military threats, the committee may decide that there exists the need for a similar framework surrounding research and dissemination of results. Indeed, the co-discoverer of CRISPR/Cas9 is a strong advocate for a more cautious approach to research, arguing that more research is needed research into the safety, efficacy and delivery in nonhuman and human systems before attempting more ambitious experiments.[108]

While research may need more oversight, there is also the argument that it needs to be more freely shared and available, particularly with regards to access to the technology in developing and low-income nations who might not be able to afford the equipment or have the scientific expertise to leverage these new advances for themselves. Indeed, it is these countries that could benefit the most from biotechnological advances in the domain of agriculture. Policies that establish conventions surrounding the safe sharing of research may alleviate this problem somewhat, while creating the risk of state-actors using said research against other states.

Indeed, another subtlety about research sharing is that there is currently no consensus as to what intellectual property protections apply to biotechnological developments.[109] The World Intellectual property organization recognized that "the business model of biotech firms often relies heavily on intellectual property rights, in particular patents, as they are often the most crucial asset they own in a sector that is extremely research-intensive and with low imitation costs".[110] Some nations allow patenting of novel methodology, while others will allow patenting of a gene with a specific function. A consensus as to what biological intellectual property would certainly assist in disseminating information on a global level. However, overly stringent patent laws could prevent both easy access to research that could potentially have novel applications, or limit the technology's implementation, for example by preventing affordable access to engineered crops in developing nations. The committee could decide to put forward a global biological patenting framework that is in some way compatible with different nations' patent systems.

As delegates can tell, biotechnology is a complex and nuanced field from the perspective of policy. It requires a sound understanding of the scientific background as well as an appreciation for the scale of the potential applications. Discussions surrounding regulation of human embryo manipulation of engineered crops will be challenging and may require nations to compromise on not only policy, but ethical and principle points. Delegates are encouraged to conduct their own research into their nation's specific situation and into the science of biotechnology, should they feel that the latter is interesting or may aid negotiations.

Futuristic Warfare

Peter Singer, author of Wired for War, noted, "too often in discussions of technology, we focus on the widget. We focus on how it works and its direct and obvious uses. […] The issues on the technical side may ultimately be much easier to resolve than dilemmas that emerge from our human use of them."[111] This sentiment is an insightful point to make at this point in history. With the rapid development of technologies, as discussed in previous sections, across all disciplines, the international community must ask themselves whether these developments may lead to mass proliferation of damaging weaponry, more frequent and devastating attacks on civilians or national infrastructure, and even the prospect of un-prosecutable war crimes due to a failure to update international law to adapt to the brave new world.

A common and much-discussed topic is that of biological weapons. The Worldwide threat Assessment report of the US Intelligence Community noted that, in the context of modem gene-editing techniques, "research in genome editing conducted by countries with different regulatory or ethical standards than those of Western countries probably increases the risk of the creation of potentially harmful biological agents or products."[112] An example cited was that of 'killer mosquitos' that could spread plagues to wipe out staple crops, or even transmit a virus that snips at people's DNA using a CRISPR/Cas9 mechanism.[113] However, delegates should note that conventions and agreements surrounding biological weapons are already in place and do carry substantial weight in international law. The 1975 Biological Weapons Convention has currently has 172 States Parties and 9 Signatory States, with only 12 states not party to the agreement.[114] The text of the Biological Weapons Convention is purposefully vague, especially Article 1 that states:[115]

Each State Party to this Convention undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes…

This text is purposefully broad and encompasses much of the modern weaponization of current gene modification developments that could arise. Indeed, even the dystopian-sounding issue of propose-engineered humans for the sake of fighting in armed forces is more than likely to be addressed by several UN documents, including International Covenant on Civil and Political Rights – which reads "All peoples have the right of self-determination"[116] – and the UN Charter itself. Thus, the question of whether the legal framework exists within which to raise these issues is essentially answered.

However, much of the discussion surrounding biological weapons have been with regard to chemical warfare and only recently have started to look at modern developments. While a war crime, the use of conventional chemical warfare has a comparatively limited scope in terms of aftermath. With CRISPR-enabled warfare a potential possibility, it may become possible to alter the very genome of the descendants of those attacked for generations to come. This could be interpreted as a violation of the Geneva Convention's provisions on collective punishment, notwithstanding the fact that it violates the Biological Weapons Convention, amongst others.[117]

Biological weapon considerations are not the only aspect involved in the future of warfare. There is also much discussion surrounding cyber warfare and lethal autonomous weapon (LAWS henceforth) and how these developments are changing the face and nature of warfare itself. LAWS refers to the identification and targeting of a human without human intervention. If such weapons were to be developed, questions will be – and indeed have already been – raised as to whether they could be used in compliance with the current rules of international humanitarian and war convention law. Questions of actual economic benefit, ethical dilemmas and purpose have all been raised and can be evidenced in the working papers of nations at the Convention of Certain Conventional Weapons (CCW) summits. The 2016 Fifth Review Conference on LAWS decided to establish a Group of Governmental Experts on Lethal Autonomous Weapons Systems that met in November 2017. The purpose of this group was to better assess the objectives and purposes of the Convention as they relate to LAWS, and to move the discussion forward by not having it under the umbrella of the CCW.[118] The report has not been released at the time of writing, but it is worth noting that it will likely shape the future of the LAWS discussions.

Human Rights Watch points out that another noteworthy development in 2016 was China's publication of its first policy position on LAWS, that found "uncertainties" in the adequacy of international law to address fully autonomous weapons and recommends the development of a legally binding instrument.[119] The paper cited the 1995 CCW protocol that preemptively banned blinding lasers.[120] China is the first permanent member of the UN Security Council to explicitly call for new international regarding LAWS. The other four members, along with other states like Israel and South Korea, instead have called for greater transparency and establishing best practices.[121]

Aside from the potential preemptive banning of LAWS, there has also been much recent discussion surrounding cyber warfare. In June 2017, talks surrounding the potential drafting of a so-called 'digital Geneva Convention' collapsed, following a dispute about whether a state could engage in self-defense in the face of an attack, as stipulated by Article 51 of the UN Charter, partly due to old Cold War tensions between Russia, China and the United States, and the difficulty of establishing who is responsible for a foreign state-sponsored cyber-attack.[122] Currently, there exists no form of international law surrounding cyberspace and cyber warfare. While progress has been made in the United Nations by accepting some negotiation base principles, the United Nations is still a long way off from developing a comprehensive legal framework.[123]

The lack of such a framework has placed pressure on some diplomatic relations. The recent WannaCrypt exploit, which encrypted infected computer's files and demanded a ransom, resulted in the United Kingdom's National Health Service's systems being taken offline for a number of days, affecting hospitals around the country, as well as other users across the world.[124] It has emerged that the exploit used for this attack was leaked from the US National Security Agency (NSA), who have been stockpiling such bugs – termed zero-day exploits – to potentially use them against aggressors. Some have likened such a scenario to the U.S. military having some of its Tomahawk missiles stolen.[125]

At a security conference, the president of Microsoft stressed the need for a 'Digital Geneva Convention' that extends the protections given by the 4th Geneva Convention in wartime to peacetime as well, arguing that it is increasingly private enterprises and civilians who are the front line, defending against cyber attacks and repairing ever-increasingly networked infrastructure, such as smart digital electricity networks that are more susceptible to cyber attacks. Some proposals he suggests include: no targeting of companies, governments or critical infrastructure, assist private sector efforts to combat, detect and prevent attacks, report vulnerabilities rather than stockpile them, exercise restraint in developing cyber weapons and peruse nonproliferation efforts, much like is the case with nuclear weapons.[126]

Such a document could be increasingly necessary, especially with the ongoing development of quantum computing methods. Traditional computers encode data as a series of ones and zeros (bits), while quantum computers encode data in subatomic particles (qubits) that can be read as ones, zeros or both in superposition. While each operation takes slightly longer than on a regular computer, theoretically quantum computers can perform many more calculations in one step. Current forms of encryption essentially consist of very large prime numbers being multiplied together and rely on the fact that reverse engineering that calculation would take a conventional computer millions of years. Comparatively, a quantum computer could theoretically do it within a few seconds, rendering current encryption useless.

At the time of writing, China is soon to launch an 'unhackable' communication network as proof of concept that leverages quantum principles to detect intruders on the network. While China is nearing commercialization of quantum communication, the United States and European nations still in early research phases, which may result in both a boon to the Chinese economy and increasing uncertainly as to the security of current communication networks.[127] With the advent of quantum computing, questions about how research is shared will again be raised, as there exists the real possibility that without access to quantum computing tools, private enterprises and states will find themselves at the mercy of those who do.

Reform

Many policy points that have been brought up in previous sections are very much applicable here. The challenges that arise with futuristic warfare are mainly due to the fact that a whole new set of norms and best practices needs to be established before any productive discussion can take place. A good example of this is with stockpiling of zero-day exploits – should that be considered to be stockpiling of conventional weapons, seeing as they can be just as if not more threatening to global security, or considered an entirely separate category of action, prohibited or not.

Additionally, another complication lies with the perceived relative urgency of certain developments. With CRISPR-enabled biological weapons, some may consider it absolutely imperative that such a weapon is never even constructed, seeing as its deployment would irreversibly harm several generations of people to a much greater extent than a nuclear bomb ever could, while others would see it as a deterrent. On the other hand, LAWS may be considered to be less important as such systems are still not deployed and if they were to be, they would cause much less damage than a CRISPR-enabled warhead, while others see the ethical questions as defining moments in the development of futuristic warfare policy.

In tackling the issues of cyber security, nations are struggling to deal with this new form of engagement. Much like how the CCW established the Group of Governmental Experts to develop policy surrounding LAWS or how the IAEA was founded to regulate the use of nuclear technologies, an independent agency that monitors and regulates the use of cyberspace, may potentially provide a solution in developing such policy.

However, in researching policy and crafting working papers and resolutions, delegates should be aware that international frameworks and laws surrounding several of these issues already exist. Suggesting contradictory policy or establishing an accountability mechanism that does not fall within the framework of the International Criminal Court or the International Court of Justice would not just be merely unproductive, it would be damaging to the efforts of this committee.

Questions a Resolution Must Address

As you begin the task of negotiating a comprehensive resolution that addresses areas of great scientific uncertainties and political controversies, you may find it hard to achieve concrete proposals and substantive reforms across all four committee topics. This difficulty is inherent in the nature of this committee: balancing the immediate threats against the long-term ones that may still require action, and navigating the different goals of states, notwithstanding the fact that the document needs to be grounded in scientific principles in order to have some kind of an impact, all contribute to this. To understand the challenges associated with creating sound scientific policy that is becoming increasingly important in the world we currently inhabit will be vital in ensuring both the credibility of the United Nations at large in addressing pressing concerns, and taking the first steps in securing the world from the devastating impacts of misuse of these developments.

All this is not to say that you are expected to achieve radical and unprecedented reform in each of the four areas of this committee. Part of the art of diplomacy and negotiation is to recognize when to accept incremental reform for the sake of greater change elsewhere, and gracefully maneuver yourself around such barriers. If during negotiations, an impasse is reached, nations may be forced to accept concessions to achieve more substantive change in other areas, perhaps with a statement of intent to return to the topic included in the final draft resolution. Giving ground can be better than nothing – although foregoing progress for the sake of it is unproductive – to achieve something rather than nothing. Substantive, detailed resolutions are more impactful than hand-wavy and poorly researched documents.

You should also not feel obliged to address all topic areas in early working papers. Over the course of the committee, you will be expected to thoroughly engage in the spirit of diplomacy to negotiate the merging of working papers into up to two – potentially three – comprehensive draft resolutions that address all topic areas in some shape or form. Draft resolutions will undergo the normal amendment procedure.

There are some open-ended questions that you may consider during negotiations while drafting a resolution. As this committee touches on a wide range of topics, this is by no means exhaustive, and you are encouraged to explore the subtleties of other questions as well.

- How can this committee incorporate concerns about national sovereignty while tackling challenges that will require multilateral cooperation?
- What balance between concrete policy proposals based on current technologies and

raising prospective concerns about potential developments should a resolution achieve?

- What lessons can be learned and applied to this committee's proposals from previous efforts to regulate and achieve oversight regarding scientific matters?
- Should the international community be regulating research or attempting to standardize ethical technological development rules on a multilateral level?
- What role will private sector companies play in the development, deployment and regulation of these futuristic technologies?
- Can a commitment be made to open and equal access to certain developments that ensure developing nations are not losing out on potentially revolutionary technologies, like cheap energy or a quantum secure communications network?
- How can this committee address the concerns that technology development is moving at a pace too fast for the international community to adequately address the issues raised by it?

Bloc Positions

It is important to note that blocs during committee discussions will be much more fluid than other single-topic committees. While you may find a key ally within one block regarding one topic, you may take a competing stance on another. This should be a consideration when joining a bloc. Broadly, some divisions may be drawn as follows:

Developed Countries // Developing Countries

This divide will be present across the board. Developing nations will seek research and scientific support from developed nations as developments in automation, biotechnology and energy generation continue to evolve and the threat of becoming 'left behind' becomes more acute. It is likely that the 'developed world' in the technological context – to include China, Russia, the United States and European nations may adopt protectionist stances to protect their developments. The formation of a united 'developed world' bloc would prove problematic for those with fewer technological or physical resources. There is also potential for division along economic policy lines, such as between the more *laissez faire* and state-controlled with respect to science research.

Nuclear States // Non-Nuclear States

These lines will become very evident during discussions surrounding energy and energy generation. Through non-proliferation efforts on behalf of UN bodies, it can be challenging for some nations to invest in nuclear fission research due to fears of them developing a nuclear warhead, as exemplified by the US-Iran Nuclear deal. With nuclear fusion research, this fear is less prevalent, as the key step in creating a hydrogen bomb – the enrichment of uranium ore – is not part of fusion generation. Yet fears may still exist surrounding weaponization of the technology. As non-nuclear states do not possess either the political vantage or technological experience to assist in developing fusion generation, they may wish the hesitant nuclear states would share their findings.

Nations with Aligned National Security Interests

A potentially interesting grouping of nations would arise due to aligned security interests – specifically against each other. A key example here could be the United States and China, who share a mutual distrust for each other, but may consider working together to ensure that the other does not benefit from the developments that they have individually achieved, or be limited by the will of international law. Conversely, nations that traditionally have not rarely together in the past, either in regional or economic blocs, may find themselves working together to ensure a mutual understanding of the sharing of scientific knowledge prevails, or peruse a more open dialogue about the state of futuristic technology developments.

Suggestions for Further Research

For some odd reason, there is a stigma that separates those interested in policy and those interested STEM (science, technology, engineering, mathematics) into two distinct and siloed categories of people. As evidenced by your reading this guide and attending the Special Summit on Futuristic Technologies, you realize that now more than ever scientists and engineers will need to contribute their knowledge to crafting international law, and likewise those less interested in the STEM fields will play a huge role in ushering such a change in. However, it is important to remember that international law and current international structures are deeply intertwined and ingrained. The high stakes of geopolitics are no less prevalent in this committee and should not be an area that is underestimated during your research. Which countries are likely to take hardline positions on which issues, and how could you persuade them to offer concessions? How will different nations tackle issues of national security, especially in an age of increased global tensions, and how likely are they to potentially sacrifice some of their sovereignty? How do the goals of your nation conform with or conflict with those of other nations? All factors must be considered, and you should, therefore, consult a wide variety of sources dealing with a broad spectrum of the international economic climate.

In keeping with the spirit of futuristic technology, you will be able to find a curated short video playlist consisting of condensed and easy to understand videos that provide a very good overview of the several of the topics this committee touches upon at *bit.ly/hmunssft*. These videos might be useful in framing some of the discussion points presented in this guide and could spur further points of inquiry and interest that you are encouraged to peruse. Some of these videos also present radical policy proposals, which may encourage you to be more ambitious in pushing for daring reform during committee.

Many of the examples in this guide have been sourced from newspapers and journals, which can offer both the story and perspective to supplement the purely technical and scientific knowledge. The BBC, the Guardian and numerous others including TED talks cover incidents on an international scale that relate to technology, while outlets like MIT's Technology Review cover issues that relate specifically to science and technology, while providing a comprehensive overview of the science behind the story. What you may find useful if you want a deeper understanding of the issues raised in this guide, or are looking for potential areas for reform, or proposals for such reforms, research publications and white papers published by UN organizations like the IAEA, IEA and CCW can be invaluable. The same can be said for private companies like Microsoft or Google, who regularly release position papers on current issues that pertain to them. United Nations documents and resolutions themselves are an invaluable resource in understanding what current efforts are being undertaken or steps that have been achieved, such as the 1975 Biological Weapons Convention. A good start might be to look at the references in this guide. Often, much of the data in those references is not included, although it may be of interest to you as you go about your research.

If you feel like you would like to supplement your own scientific knowledge, plenty of valuable resources exist online, from the most basic (e.g. BBC Bitesize) to more advanced (e.g. Hyperphysics, university resources). Naturally, plenty of accessible textbooks exist both online for free and in your school and local libraries that may provide more concrete scientific knowledge. Although not required, if any of the topics brought up in the guide pique your interest in this regard, absolutely peruse further research into it.

To provide some interesting fiction that charts how various authors thought the world could develop, George Orwell's *1984* and Aldous Huxley's *Brave New World* both describe a dystopian world in which technology, coupled with human behavior, resulted in an unimaginable world. The authors take the idea in different directions, and if literature interests you then I cannot recommend these novels more highly.

Position Papers

When researching the issues this committee will be addressing, delegates must bear in mind that governments' policies are affected by their national political and economic situation. For instance, the United States National Security Agency did not disclose zero-day exploits, yet there is political pressure on the US government to be more transparent and communicative in addressing the growing threat of cyber warfare. You will have to weigh these often-competing pressures when you formulate your country's position.

Writing your position paper will help you understand and frame the topics being discussed, forcing you to think creatively about complex problems that may not have been mentioned in this guide and how your country would position itself within that debate. You are unlikely to find a concise summery of your country's position on each one of the above topics, but I encourage you to think logically and rationally about what would be in your nation's best interests, and indeed for the international community at large. I will not penalize delegates for taking a different approach than their assigned country has in the past, as the issues being discussed are quite niche and in many cases, policy may not even exist. Providing you can justify a change in policy by pointing out political and scientific developments at a national level, I would view such a change very favorably, as better reflecting the actual purpose of the committee.

Position papers should generally have three parts. The first should be a statement of the problem and the central issues that the committee should address – the most pressing concerns. These should be both from your nation's domestic perspective and from a sweeping, global perspective. The second section should be an explanation of how your nation is affected by some of the topics up for discussion in this committee, providing an opportunity for you to justify and provide context to the policy approach you will take in committee. As there are many topics featured, some will naturally weigh heavier on certain countries than others, thus I would encourage you to not discuss all topic areas and instead to give priority to the issues that your nation would naturally prioritize.

The most important section of you position paper, which should be reflected in the time you dedicate to it, will be the proposal of solutions. Here, you should outline your nation's general policy on contentious areas in the background guide: what your key priorities in negotiations will be, the areas you are willing to concede ground on, potential areas of conflict with other nations. You should also propose original ideas for addressing the issues that will be discussed. These should be specific, in your nation and the world's interest, and geared towards addressing the nuances of the issues presented in this guide – as well as considering how to deal with potential opposition, and possible compromises you would be willing to make on its implementation. Due to the mixture of concrete and less concrete issues this committee will raise, this section need not consist solely of concrete solutions, but should also seek to frame your country's position on the issues within the larger context of the committee's goals.

These position papers are representation of a nation's position and not a statement of your personal opinion. Therefore, they should be written formally and in third person. For example, a paper written from the perspective of Nigeria should read, "Nigeria believes that…". Position papers should be at least two single-spaced US letter (8.5" x 11") pages in size 12 font, with one-inch (2.54cm) margins. Please follow the guidelines on harvardmun.org for the heading of the position paper.

Closing Remark

Allow me to thank you sincerely for reading this background guide. Although the information in it may be dense, I hope that it has given you a useful insight into the many ways science policy will affect the international community and ultimately every single one of us. I hope that you will take the guide as a starting point and do further research and formulate your own beliefs. While it is important that you attempt to represent your country's position in the model UN framework, the goal of running this committee is to hopefully spark an interest in learning more about how important science, technology, engineering and mathematics are to international relations, and to provide a slightly different model UN experience than what you may be used to.

I believe that the international framework of the United Nations and goodwill of nations is robust enough to withstand this tumultuous time in recent history. While the very way the world works changes rapidly and irreversibly, international organizations must adapt with equal agility. You all are capable of showing that this is possible, and I cannot be more excited to have the honor of directing the Special Summit on Futuristic Technologies, where I hope you explore new or old interests and forge lifelong international friendships.

I cannot wait to meet you all in Boston, and if in the meantime, you have any questions about this committee, please do not hesitate to get in touch.

With best wishes,
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