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Tackling Technology: Three Proposals for Rio
Contribution to the Rio+20 Zero Draft
ETC Group

Introduction

The most dramatic technological transformation in history – involving information technologies, biotechnologies and engineering – has occurred since the first Rio Earth Summit in 1992; during the same period, however, governments have systematically downsized or eliminated their capacity to understand science and monitor technologies. While technology has thus far played an extraordinarily prominent role in preparatory documents for Rio+20, technology's potential contribution to sustainable development and/or new Green Economies cannot be realized as long as the world lacks trusted and transparent mechanisms – at global, regional and national levels – for technology evaluation. The absence of such mechanisms incites distrust and invites disaster.

At Rio+20, governments need to adopt forward-looking strategies that will make tangible progress toward sustainable development through policies empowered to:

1. Assess in a comprehensive way the social, economic and ecological impacts of new technologies and to share information about them;
2. Ban geoengineering (the large-scale technological manipulation of the Earth's systems as they affect the climate; and
3. Support small-scale peasant-led agriculture that reduces waste, protects biodiversity and enables rural livelihoods.

All of this must be accomplished with the active participation of civil society groups, especially the communities that are most likely to be affected by decisions at the Summit.

1. Technology Assessment: Orphaned in Rio

In the lead-up to the 1992 Rio Earth Summit, the Swedish government prepared a proposal for a global facility called "SIIESTA" (Stockholm International Institute for Environmentally Sound Technologies Assessment). Somewhere on the road to Rio, the initiative went to sleep but, nevertheless, Agenda 21's Chapter 34[1] called for regional capacity-building for technology assessment.

Post-SIIESTA developments – *"While we've been sleeping:"* A year after Rio, the UN all but eliminated its Center for Science and Technology for Development (UNCSTD), moved the remnants from New York to UNCTAD in Geneva, and, simultaneously, eradicated its Centre on Transnational Corporations (UNCTC), thus terminating the minimal global capacity that had existed to monitor and advise on new technologies and on private sector technology transfer. In other words, as IT and biotech ushered in the so-called "Knowledge Economy," the UN gave itself a frontal lobotomy.

Since the Earth Summit...

- **IT**: From a handful of clunky mobile phones in 1992, there is now a cell phone for everyone; almost half of Africa has a mobile, up from one in five six years ago; and, more than 800 million people are on Facebook;

- **Biotech**: At a cost of $60-$100 million per trait, biotech has invented herbicide-tolerant crops, *Terminator* seeds that die at harvest forcing farmers to buy seed every season; and (under development), *Zombie* seeds that can only regenerate when immersed in proprietary chemicals;
- **Knowledge Economy:** We're being told that we are moving from the "Knowledge Economy" of the late 20th century to the "Green Economy" of the 21st but the real change is in ownership and control. The world's markets sell 10 billion products based upon an estimated 100,000 chemicals based upon 100 elements and the four nucleotide bases that comprise DNA. Whoever controls the chemical elements and the A, C, G and T of DNA controls the fate of sustainable economies;
- **Genomics**: The speed and cost of mapping the human genome has dropped from 13 years and $1.3 billion to 14 days and $5000 *en route* to 15 minutes and a few hundred dollars soon after 2012;
- **Nanotechnology**: Governments have spent more than $50 billion on nanotech R&D; the cost of carbon nanotubes has dropped by a factor of 20 since 2001; there are thousands of consumer products; and, there is no agreed nanotech definition or regulation;
- **Synthetic biology**: Undergraduates with $400 gene synthesizers can download templates to build DNA while scientists can create self-replicating artificial microbes and six letter DNA; six of the world's top 10 energy corporations have partnerships with synthetic biology start-ups, as do six of the world's top 10 grain traders and six of the world's top 10 chemical corporations.[2]
- **Robotics**: Amateurs with $1300 3-D printers can collaborate to build unmanned aircraft (drones) in seven days for around $8000;
- **Convergence**: Governments and scientific institutions are predicting the unification of "Bits, Atoms, Neurons and Genes" (BANG) as the next Industrial Revolution transforming trade, economies and industrial production;
- **Engineering**: Industry now displaces more earth *per annum* than is lost through natural erosion; the annual runoff from aquifer mining nearly matches the sea level rise from the "melt" of Polar glaciers; and there is 3 to 6 times more water dammed than in natural rivers;
- **Geoengineering**: Since 1993, governments and/or corporate consortia have conducted a dozen major ocean fertilization experiments and are proposing solar radiation management techniques that could alter global or regional climates.

The greatest technological transformation in history has occurred over the last 20 years while governments systematically downsized or eliminated their capacity to understand science and monitor technologies.

The Case for Technology Assessment: A trusted, transparent pathway for technological advancement could be beneficial for societies, governments and those introducing new technologies. Major innovations inevitably lead to Schumpeter's "creative destruction," but innovators and their backers seek to minimize risk. Especially, re-insurers and investors welcome steps that make government intervention and/or public responses more predictable.

Stabilizing the Playing Field and Getting Off the Rollercoaster: From very different vantage points, both science and society feel they have had a rough ride the last couple of decades. The

rollercoaster has almost derailed leaving not only scientists but start-ups and venture capitalists technologically traumatized. A few socially and financially costly examples – all since the 1992 Earth Summit – follow:

- **1996:** Mad-cow disease/Bovine spongiform encephalopathy (BSE) (UK);
- **1996:** GM crops (Europe/global);
- **2001:** Hoof and mouth disease (UK/Europe);
- **2006:** Nanoparticles (Germany, China/global);
- **2007:** Agro(bio)fuels (global);
- **2009:** Intellectual property distortions (global);
- **2010:** Deep water drilling (USA/global);
- **2011:** Nuclear power (Japan/global).

1996 – Mad-cow disease/Bovine spongiform encephalopathy (BSE): Although British regulators knew in the 1970s that the public was being exposed to BSE, the information was covered up until 1996.[3] The fallout from the regulatory failure has meant continuing societal distrust in the UK and Europe.

1996 – GM crops: Civil society initially warned that the biotech industry was developing herbicide-tolerant plant varieties in 1981. Governments and societies were nevertheless shocked when, in 1996, the first genetically modified crops were planted. In several parts of the world, small-scale producers immediately opposed the GM seeds as a potential threat to their environment, their health and their markets. Likewise, many food retailers and their customers opposed GM foods in the absence of credible scientific evidence that the products were safe – or had even been tested. Because some governments adopted the precautionary principle while others simply adopted the technology, markets and global trade became uncertain and many parts of the food system suffered. All parties agree that the story of the introduction of GM crops is now *the* textbook example of how governments and industry should *not* function.

2001 – Hoof and mouth disease: The regulatory scandal and financial losses from the 2001 outbreak of foot and mouth disease in the UK (and then Europe) severely undermined citizen confidence in government regulation. In the end, the outbreak's cost totaled $16 billion in the UK, where 7 million sheep and cattle were killed. Governments haven't learned from 15 other outbreaks of the virus – including another in the UK in 2007. According to the US government, the risk of an accidental escape of foot and mouth disease virus from a federal lab is 70% over 50 years at a cost of around $9-50 billion. The US National Academy of Sciences said the government's estimate was low.[4]

2006 – Nanoparticles: The estimated annual global market for nanotechnology varies widely between about $100 million and $100 billion and predictions for the near-term range from hundreds of billions to almost $3 trillion. There is agreement, however, that governments have spent more than $50 billion on nanotech R&D since 2001 and industry is now outspending governments in nano research. Several thousand products – including foods, pesticides and cosmetics – are in the marketplace today. Where so much money has been spent (and so many products are already on the shelf), it is unlikely that governments will respond well to scientific concerns for health and environmental risk. Even today, there is neither an inter-governmentally

accepted definition of nanotechnology nor agreed methods for measuring or evaluating nanoparticles. In 2006, a housecleaning product called "Magic Nano" was briefly on shelves in Germany but was withdrawn almost immediately when nearly 100 consumers telephoned poison-control centers concerned that the product had caused respiratory and other problems. In the absence of any agreed definition, industry insisted that the product was not actually "nano" and while the product was removed, nanotechnology companies insist the experience had nothing to do with nanoparticles. More recently, seven female workers in China who were exposed to a polymer/plastic ingredient in an adhesive paint containing nanoparticles became sick with breathing problems; two of them died. A team of Chinese scientists examined the lung tissue of all seven women, found nanoparticles lodged in cells of the lungs and concluded, cautiously, that the seven cases raised concerns that long-term exposure to some nanoparticles could be related to serious damage to human lungs.[5] Again, absent rules and regulations and definitions, there is no certainty as to the role of nanoparticles. The only certainty is that nanotechnology is virtually unregulated anywhere in the world.

2007 – Agro(bio)fuels: In October, 2011, a special report commissioned by the High-Level Panel of Experts of the UN Committee on World Food Security concluded that the world food price crisis that became evident at the end of 2007 was greatly exacerbated by the rapid rise in production of so-called biofuels. Since 2007, governments around the world have been engaged in internal and external debates on the biofuels issue. From the beginning, industry and some governments have insisted that a second or third generation of biofuels would soon be available that would allow governments to feed people and fuel cars simultaneously. Every growing season has witnessed new pronouncements of the imminent arrival of these new technologies. Four years and almost a billion hungry people later, the world is still waiting. If the UN had had a technology assessment capacity in place, the biofuels illusion would not have prevailed and 170 million additional people would not have gone hungry.

2009 – Intellectual Property Distortions: More an ongoing dilemma than a singular event, IP is a different kind of regulatory failure. There is widespread agreement that the intellectual property system, rather than facilitating innovation, is a financial and legal barrier to new technologies. The very system that was constructed to propel creativity, we were told, is now – obvious to all – one of its worst enemies. This is not a situation where the physician can heal himself. According to a 2009 study, total US corporate profits from patents (excluding pharmaceuticals) average around $4 billion annually – but the associated litigation costs are $14 billion per year.[6]

2010 – Deep Water Drilling: The BP Gulf of Mexico oil disaster of 2010 is well documented. Less known is that in 2008, a near-disastrous offshore gas leak in Azerbaijan led to the biggest personnel evacuation in the driller's history. The company was BP and a WikiLeaks disclosure says that officials at the time blamed the leak on faulty cement casings – the same problem identified in BP's Deepwater Horizon spill 18 months later.[7] Hubris has no memory. BP estimates that the cost of the Gulf of Mexico spill could reach $40 billion.[8] Between 2007 and 2009 there were 381 fires (reported) on oil rigs in the Gulf of Mexico – about one every three days. Every year, 760 million litres of oil spill into the world's oceans – that's an annual BP Gulf disaster.[9]

2011 – Nuclear power: The Fukushima tragedy that began March 11, 2011 is the latest in a succession of scandals that has befallen the commercial nuclear power industry since its inception in 1953. The Fukushima facility was assessed to be tsunami-resistant because a high cliff separated the construction site from the ocean. Immediately following this assessment, however, the cliff was removed to allow boats to bring heavy equipment to the site. Following the tsunami, Fukushima was plagued by a number of other technical and political failures. The nuclear power industry's situation worsened when subsequent studies revealed that 88 of the world's 442 operational nuclear plants have been built on seismic faults.[10] Additionally, for almost 60 years, the industry has struggled with nuclear waste disposal. Despite constant assurances, no country has solved the problem. The UN's 2011 *World Economic and Social Survey* reported that the industry has been beset with problems since its Cold War beginnings. The industry originally adopted nuclear submarine standards that prioritized compactness and mobility – both irrelevant to the industry. The decision caused enormous difficulties, delays and cost overruns. By the 1970s, the nuclear companies were confronted with new regulations every day, forcing the near-collapse of one of the world's most powerfully-backed technologies.

In preparation for Rio+20, governments and UN agencies have focused on further elaborations of the concept of sustainable development and/or proposals for new Green Economies. The potential for new technologies has played an extraordinarily prominent role in preparatory documents. UNEP's report (*Towards a Green Economy*) references technology 655 times while the UN's *World Economic and Social Survey* ("The Great Green Technological Transformation") mentions technology over 1200 times. While these documents focus, importantly, on technology transfer and capacity-building, such a heavy emphasis on new technologies must include a strengthened global, regional and national capacity to monitor and assess the technologies. To do otherwise would be to incite distrust and invite disaster.

Elements of Technology Assessment – the dual track imperative:

Enormous financial and political interests are often mobilized to block "game-changing" new technologies from disrupting the *status quo*; or, as often, to propel new technologies into the marketplace prematurely to gain first-mover advantage. Given the importance of new technologies in government and social planning, "backup" assessment mechanisms are necessary. The intergovernmental assessment system must be supplemented by a civil society mechanism that can offer alternative perspectives. In brief...

- Intergovernmental assessment;
- Civil assessment.

Intergovernmental assessment: Decisions at Rio+20 should ensure that the United Nations will expeditiously develop the institutional capacity to identify and monitor significant technologies, and to provide assessment of the technologies' social, economic, cultural, health and environmental implications. This should be done at the time of the application to release a new technology and, preferably, in advance of such an application in order to minimize waste and risk. Monitoring and assessment of new technologies should be based on the Precautionary Principle, and led by designated working groups, including a diversity of experience in science and other forms of knowledge, as well as a range of stakeholders. Reports of working groups

should be submitted to an intergovernmental body that facilitates the full participation of civil society. The working group's report should be appended to the final report and recommendations of the intergovernmental body. The intergovernmental body should also monitor and report on the diversity of available technologies and the safe archiving of technologies no longer (or seldom) in use.

Civil assessment: Recognizing the power and impact of major new technologies, governments and the United Nations should encourage the formation of dynamic civil society mechanisms that can offer an independent monitoring and assessment capacity to accompany intergovernmental processes. This initiative should encourage the formation of self-organized civil society mechanisms at the regional and inter-regional level that could guide Technology Observation Platforms (TOPs) capable of undertaking regionally-relevant reports on technology risks and opportunities to be considered by the intergovernmental body identified above. Secondly, governments and the United Nations should encourage the formation of a "Technopedia" as an open access, web-based technology assessment tool monitored and maintained in the participatory style of Wikipedia.

Technology Assessment's Place in the Multilateral Firmament:

Given the pace, power and complexity of new technologies, "due diligence" requires that governments seeking technology transfer or capacity building *or* funding science and technology (through grants, tax breaks and/or intellectual property policy, etc.), have effective capacity for technology monitoring and assessment. Recognizing the global impact of many new technologies developed at the national level, there is obvious need for – and efficiency in – technology assessment at global and regional levels. There are several ways in which this could be accomplished:

- Treaty – International Convention for the Evaluation of New Technologies (ICENT);
- Mainstreaming across the UN system:
- CSD/ECOSOC expanded capacity;
- UNGA Office of Technology Assessment;
- Special Rapporteur on the Right to Innovate/Imitate

Treaty – International Convention for the Evaluation of New Technologies (ICENT): The negotiation and implementation of a discrete treaty for technology assessment might ultimately prove to be the most efficient and least costly mechanism for global technology monitoring. ETC Group has drafted the template for such a treaty that governments may wish to consider. It is possible that Rio+ 20 could adopt a process and timetable for Treaty negotiation. However, it would likely involve a 5-10 year negotiating process.

Mainstreaming across the UN system: The United Nations has constructed a number of science/technology instruments in recent years that offer useful elements that could evolve into technology assessment mechanisms. In every case, however, the scope or "terms of reference" of the instrument is restricted to a specific field such as agriculture or climate or biodiversity. While it is entirely possible to enlarge the mandates of some of these initiatives and to link them

together, the task of creating and maintaining these linkages may prove more difficult than establishing a unique entity.

Some examples of existing scientific instruments...

- **IPCC (Intergovernmental Panel on Climate Change):** a very large community of scientists collaborating on the assessment of the science of climate change that has achieved broad social and governmental support almost everywhere in the world. However, the IPCC has only been mandated to review existing studies about climate change – not to evaluate new technologies. It would be difficult – and possibly dangerous – to add to the IPCC's burden by giving it the responsibility to evaluate climate-change related technologies.

- **SBSTTA (Subsidiary Body on Science, Technology and Technical Advice):** Both the CBD (Convention on Biological Diversity) and the UNFCCC have scientific subsidiaries that offer a combination of scientific and political advice to their respective Conferences of the Parties (COPs). In effect, the SBSTTAs have functioned as intersessional bodies for the COPs rather than as scientific advisers.

- **IAASTD (International Assessment of Agricultural Science, Technology and Knowledge Systems for Development):** At the request of governments at the Johannesburg World Summit on Sustainable Development (Rio +10), FAO, the World Bank, governments and UN agencies collaborated to create an extraordinarily broad assessment of agriculture, which included input from small-scale producers and considered different knowledge systems. The report has won broad support. Rio+20 should ensure that this work carries on either as an independent entity or that it be built into another evaluation mechanism.

- **HLPE (High-Level Panel of Experts on Food and Agriculture):** In 2009, the UN/FAO Committee on World Food Security (CFS), in conjunction with FAO, established the HLPE as a widely representative panel of experts to examine critical issues and to provide independent reports to the CFS. Thus far, the panel has worked remarkably well and has earned the respect of diverse stakeholders. While the mandate of the HLPE is broad, it does not include the full range of new technologies that could impact the earth and its inhabitants.

- **IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services):** Initial meetings to establish the IPBES are still underway and the outcome remains uncertain. IPBES is expected to have a strong mandate to address biological diversity and ecosystems services and this could readily include the assessment of technologies affecting these systems. However, its future relationship with the IPCC on climate change or the HLPE on agriculture remains to be negotiated. Nevertheless, if one of the predicted outcomes of Rio is an enlarged UNEP with additional resources and membership – and responsibility for IPBES (not yet decided) – then it would be important to make sure that technology assessment is part of its new agenda.

In sum, while each of the initiatives identified above can play a useful role contributing to technology assessment, either their mandate or their history limits their ability to function on a global cross- or multi-technology platform. Because its role and work are still being negotiated, IPBES may be the one exception that could be given wider duties.

CSD/ECOSOC expanded capacity: Were governments in Rio to agree to expand the mandate and strengthen support for the current CSD into a Council on Sustainable Development – or to commit additional resources to ECOSOC – then it would be logical to place a committee secretariat for technology assessment within the revitalized body.

UNGA Office of Technology Assessment: Perhaps one of the most straightforward and attractive options would be to establish an Office of Technology Assessment (OTA) attached to the UN General Assembly. The OTA could undertake studies and report directly to the General Assembly. The OTA would need a strong secretariat and resources commensurate with its task, and governments in Rio would have to move carefully to ensure that the OTA is capable of meeting its mandate.

Special Rapporteur on the Right to Innovate/Imitate: Appropriate technologies, if carefully evaluated and globally shared, could help us develop more sustainably and meet the Millennium Development Goals. It is well established that current systems of technological innovation and dissemination are failing the global South, and that developing countries encounter many obstacles in accessing appropriate technologies, and being able to use, maintain and develop them. This is an overlooked human rights issue: the right to share in the benefits of scientific progress (or, more prosaically, the right to innovate and imitate) are established within Article 27 of the Universal Declaration on Human Rights and Article 15 of the International Covenant on Economic, Social and Cultural Rights. The creation of a position of a Special Rapporteur on Article 27 could help document the human rights dimensions of technological developments, encourage appropriate technology transfer policies, warn of rights violations that new technologies might entail and highlight the right of all human beings to share in the benefits of scientific progress. Governments at Rio+20 should agree to establish this position and ensure it has the resources it needs to fulfill its mandate effectively.

Governments, at Rio+20, should agree to convene, within three years, a UN Innovation Summit to fundamentally re-examine and evaluate mechanisms for the promotion of innovation through diverse knowledge systems.

The Road from Rio: It will be important for governments and civil society to know what has been accomplished in the Rio process. We believe the following are reasonable indicators of progress or failure for the advancement of technology assessment within the United Nations:

We have made progress if Rio…

- Adopts a Technology Assessment Mechanism at the global level (at least), and/or;
- Accepts a negotiating process and timetable to establish a mechanism, and/or;
- Identifies potential locations and a process/timetable for discussion.

We have failed if Rio…

- Invites agencies/treaties to consider tech assessment in upcoming meetings, and/or;
- Concedes only that technology transfer does not exclude assessment, and/or;
- Sets no process/timetable for further discussions.

2. Geoengineering – Planetary Technofix?

Geoengineering is the intentional, large-scale manipulation of the Earth's climate systems by artificially changing oceans, soils and the atmosphere. Simply put, geoengineering is a technological fix for climate change on a planetary scale – one that may have devastating environmental, economic and social impacts, particularly in the global South.

The idea of re-engineering the planet used to be the stuff of science fiction, but a group of increasingly vocal advocates and policymakers in Western capitals is rapidly moving these controversial ideas from the margins to the mainstream of climate policy. Controversial experiments are being proposed[11] and no international authority is overseeing decision-making. The list of governmental and intergovernmental bodies now dealing with the topic is growing: Parliamentary and Congressional Committees in the UK and USA, the US Government Accountability Office, the UK Royal Society, the US National Academies, the Intergovernmental Panel on Climate Change, the Convention on Biological Diversity, the London Convention and Protocol.

The peoples and countries and peoples that will be the first to suffer the impacts of these experiments have not been consulted. The 193 Parties to the Convention on Biological Diversity were alarmed enough at COP 10 in Japan in October 2010 to adopt a moratorium on geoengineering activities that could threaten biodiversity and have transboundary impacts.[12] Rio+20 needs to buttress that decision with a firm global ban on the testing and deployment of all geoengineering technologies in the absence of a clear international consensus. The legal precedents exist in international arms control.

Disarming the Weather Warriors: Most discussions on the governance of geoengineering have revolved around the potential applicability of various international legal regimes to specific geoengineering techniques (e.g., London Convention and Protocol on Ocean Dumping, the Convention on Biological Diversity, the Vienna Convention on the Protection of the Ozone Layer and its Montreal Protocol. While these treaties are useful tools, a more comprehensive and simple solution, in keeping with the spirit of the moratorium adopted by the CBD in October 2010, would be to ban the testing and deployment (through any form of *in situ* experimentation) of all geoengineering technologies either through the ENMOD treaty (on environmental modification) or drawing on our experience with disarmament. This would allow theoretical research, computer modeling and laboratory tests to proceed but would draw the line at real-world experimentation.

A ban on geoengineering testing could be negotiated during the remaining months of the preparatory process and adopted at Rio+20. Alternatively, states at Rio+20 could signal their intention to submit a resolution to the UN General Assembly banning geoengineering. A General Assembly resolution could launch negotiations on a treaty or even form the basis for a treaty,

which would then be opened for formal signature and ratification. A treaty would specify that no Party could engage in the real-world experimentation of geoengineering technologies. An international body, akin to the International Atomic Energy Agency, would then have oversight and inspection powers in order to ensure compliance. This could be a new or an existing body with an expanded mandate.

Under the Nuclear Non-Proliferation Treaty (1968), which 190 states have ratified, non-nuclear weapons states agree not to seek or manufacture nuclear weapons and nuclear weapons states agree to engage in disarmament talks. The only states that do not honour the ban on military research are the five nuclear powers that are the permanent members of the Security Council (USA, China, Russia, UK, France) and the four other states that have more recently acquired nuclear strike capability (India, Pakistan, Israel, North Korea). The Comprehensive Nuclear Test Ban Treaty, which has been ratified by 155 states but has not yet entered into force, prohibits all nuclear explosions. Parties also agree to prohibit any such testing in areas under their jurisdiction and refuse to participate in any way in such tests.

The Chemical Weapons Convention (CWC) is an arms control agreement that outlaws the production, stockpiling and use of chemical weapons and it has been ratified by 185 states. The Biological and Toxins Weapons Convention expanded the Geneva Protocol, which prohibited the use (but not the possession) of biological weapons. Currently, 165 states are bound by its provisions, which prohibit the development, use and stockpiling of the instruments of biological warfare. While both these treaties have weaknesses, particularly in terms of their monitoring and compliance mechanisms, the basic framework of the treaties is relevant to geoengineering: What is prohibited is not the actual biological agents, but rather their uses. What is made illegal under these conventions is the preparation for the waging of biological warfare. The parallel that can be drawn with climate modification through the deliberate, large-scale technological manipulation of the Earth's systems is straightforward: It is the testing of technologies that purport to engineer the climate at a large-scale that would be prohibited, not the actual materials or processes that would be used.

Advocates for geoengineering sometimes argue that a ban or even an international governance system cannot be adopted because the technologies have not yet reached a stage of maturity, and scientific exploration should not be hindered by "premature" regulation.[13] This argument is wrong-headed. What the history of the nuclear arms race shows is that problems are created precisely because some states already possess the technology. The reason the Comprehensive Nuclear Test Ban Treaty has not entered into force is that an insufficient number of states with nuclear technology have signed on. Likewise, the "new nuclear states" resent having restrictions on testing that the "old nuclear powers" do not have. This is seen as inequitable and ineffective. With geoengineering technologies at a stage of relatively immature development,[14] the world actually has a small window of opportunity to prohibit them before financial and geopolitical interests become entrenched.

Nine Questions to Debate Before Considering Geoengineering Deployment

Intergovernmental discussion on geoengineering should include careful consideration of each of the following nine questions. ETC Group offers preliminary thoughts:

I. **How intrinsically risky is geoengineering**? The risk is proportional to the planetary scale upon which it would operate and, like nuclear war, its effects are not reversible or predictable. Scientists agree that the outcome of geoengineering cannot be certain, therefore, the risk is commensurate with that of nuclear war.

II. **Are the risks evenly distributed among regions and peoples?** Scientists agree that the impacts of geoengineering would be uneven and probably unpredictable within and between hemispheres and continents. People would also be differently vulnerable depending upon their livelihoods, locations and mobility (wealth). Marginalized people in fragile environments – exposed to extreme hydro-meteorological events and circumstances – would experience disproportionate risk.

III. **Could geoengineering's development/deployment negatively impact other responses to climate change?** All parties recognize that the prospect of even temporary technological fixes to climate change encourages some governments and industries to lower their (already weak) commitment to mitigation and adaptation. Further, if technological alternatives are thought to be "cheaper", other options and funds will attract less support. There are also direct impacts on other mitigation responses, such as less effective solar power in the presence of solar radiation management techniques.

IV. **How will decisions be made?** This is unknown. However, as with nuclear weapons and other major global military and economic issues, geoengineering decisions will be made by those who have power. Because geoengineering could conceivably be undertaken by just one (or a few) countries, multilateral endorsement is not a prerequisite for action.

V. **What is our experience with responsible global crises management?** Humanity's only comparable experience is with war. Powerful governments have never left such decisions to an inter-governmental vote. These governments have conducted ocean and stratospheric nuclear testing without UN support. It could be argued, of course, that hunger, disease and poverty are also global crises requiring a coordinated multilateral response. At least since the 1960s, we've been told that these problems are financially and technically solvable. Concerted, constructive action has been rare.

VI. **What is our global record with equitable problem-solving?** Governments have negotiated thousands of treaties that achieve practical solutions to practical problems. The solutions have sometimes been equitable. However, when it comes to the "big" issues of war and peace, justice, or equitable distribution, humanity has very few beneficial experiences to draw upon.

VII. **What are the mechanisms for the participation of less powerful parties and those regions and peoples that could be most negatively impacted?** The issue has not been addressed. There have been discussions about governance in general, but proponents of geoengineering have not developed any mechanisms to meaningfully engage marginalized peoples or countries.

VIII. **What risk is there that scientific advice could be superseded by short-term political interests?** As climate change shows, scientific advice is routinely marginalized or distorted to meet immediate political interests. Scientists lose control of their information/advice the moment it encounters the political agenda. This distortion has been consistent: from the health effects of tobacco, asbestos and radiation to BSE and nuclear safety today (see below, Table 1). The greatest consistency, however, is that scientists have failed to learn from history.

IX. **What is Plan C if geoengineering fails or exacerbates climate change?** Good question. No answers – just wasted time and money.

The Road from Rio: Rio+20 affords all of the world's governments their best opportunity to make a clear statement on the unacceptability of geoengineering. If the message from Rio is not clear, some governments and some companies will pursue ocean fertilization and/or solar radiation management research that could threaten the environment and well-being of other peoples. The following might be considered indicators of governments' views coming from Rio:

We will have made progress if Rio…

- Makes a clear statement that geoengineering is unacceptable, and/or;
- Adopts text hostile to geoengineering with no loopholes, and/or;
- Welcome/approves the existing CBD moratorium without reservation, and/or;
- Exposes geoengineering as a controversial and dangerous initiative being pursued by parties sidestepping climate change obligations.

We will have failed if Rio…

- Calls for further scientific experimentation in geoengineering techniques, and/or;
- Implies that "all options" must be "on the table," and/or;
- Asks one or more scientific "taskforces" to study and report.

3. Agriculture – The BioMassters' Greed Economy?

ETC Group supports the important emphasis given to agriculture in Agenda 21 and agrees with governments that food and agriculture must play an essential role in the movement toward sustainable economies. We believe that the IAASTD report, requested by governments during the 2002 World Summit on Sustainable Development, is the basis for strengthening the role of small-scale producers in achieving Food Sovereignty. We also commend the leadership of the UN Food and Agriculture Organization (FAO), International Fund for Agricultural Development (IFAD), World Food Program (WFP) in restructuring the Committee on World Food Security (CFS), ensuring the full participation of small-scale producers, civil society and multilateral institutions, including the Consultative Group on International Agricultural Research (CGIAR), and creating new policies and new governance structures for food and agriculture. The High-Level Panel of Experts (HLPE) established to work with the CFS has also made an important contribution. We believe that the revitalized CFS – guided by the findings of the IAASTD – is the appropriate body to work with governments to develop sustainable economies for food and agriculture. Governments should give consideration to the CFS model as a possible template for

the development of any new or revised environmental mechanisms that may result from the Rio+20 conference.

The Need to Shift from Food Chains to Food Webs:

Today, six corporations (Monsanto, DuPont, Syngenta, Dow, Bayer, and BASF) control 71% of crop chemicals, 58% of commercial seed sales; and, with their biotech partners, control 77% of the world's so-called "climate-ready" crop patent claims. The six-company oligopoly stifles innovation, encourages energy waste and promotes their polluting chemicals.

The industrial food chain offers the same sadly simplistic solution to all the problems it creates: governments and consumers must give them more money to develop technological "quick fixes" that will give agribusiness the power to adjust food supplies to climate change; reduce greenhouse gas emissions; conserve the world's diminishing water resources; safeguard biological diversity, and; feed 9 billion people in 2050. All governments need to do is suspend their common sense and trust the oligopoly that has made our food system so unsustainable and left almost 1 billion people hungry. In reality, it is sound policies – not unproven science fiction – that will address humanity's needs. Below are **20 practical policy initiatives that can be implemented now** that will immediately strengthen food sovereignty, reduce environmental damage and support the innovative work of peasant producers.

Fundamental policies for the land and people

1. **Restore public support for agriculture to address the food crisis.** Corporate concentration in the food chain has, since at least the 1970s, severely reduced public-sector support for both research and rural development. Agricultural assistance declined from $8 billion in 1984 to $3.4 billion in 2004 (2004 US$).[15] Governments should cooperate to place an annual $5 billion surtax on the food oligopolies over at least the next 25 years to recoup a portion of these losses. The recovered funds should go directly to peasants' organizations to support their initiatives.

2. **Convert "land-grabs" to peasants' fields.** There is growing international recognition that public or private internal or cross-boundary land grabs are destructive of the environment and food security. The estimated 80 million hectares of land[16] involved in these transactions should be made available to peasants and converted into 26.7 million farms of roughly 3 hectares each.

3. **Convert biofuel land to food.** In 2007, both the US and EU devoted $11 billion to state subsidies and tariffs in support of biofuel production. As of 2006, 14 million hectares (1%) of all arable land was being used for biofuel production[17] (providing only one half of 1% of global primary energy use.)[18] New policies should transfer biofuel land to 4.6 million landless or land-poor peasants (3 hectares each) – potentially doubling farm production (average farm size in Africa and Asia is currently 1.6 ha).[19] The $11 billion annual subsidy should support agro-ecological developments on the farms.

4. **Secure sufficient, nutritious and appropriate food for at least 9 billion people by 2050.** Today, the cereals used for animal feed could meet the annual caloric needs of more than 3.5 billion people.[20] The current world population is 7 billion. There is no technological barrier to meeting our future food needs.

5. **Adopt policies that reduce soil erosion to protect long-term food security.** Today, the industrial food chain leads to an annual loss of topsoil amounting to 75 billion tonnes and costs the world $400 billion.[21] An oligarchy of ten global fertilizer companies discourages good soil management.[22] Peasant soil conservation systems utilizing naturally occurring soil microorganisms are responsible for fixing 140-170 million tonnes of nitrogen – equivalent to $90 billion in chemical fertilizers.[23] Policies must support these conservation strategies. Improved land management, especially using peasant techniques, could increase agricultural GDP between 3% and 7%.[24]

6. **Reduce crop losses:** Today, annual food losses equal more than half of the world's cereals crop (2.3 billion tonnes), meaning unnecessary production of roughly 500 million tonnes of GHG. Food losses in industrialized countries range between 90 and 111 kg per person per year. New policies should immediately lower OECD crop losses by 90% – at least to sub-Saharan African and South Asian levels of 9-11 kg per person per year.[25]

Policies to transform the food chain into a food web

7. **Strengthen the food web and break up the food chain.** Oligopoly in agricultural inputs reduces efficiency and discourages the resiliency necessary to respond to new health and environmental challenges. Competition policies must break up the food chain. New policies must encourage market diversity and research support for agro-ecological systems. Market diversification, for seeds alone, could reduce prices by at least 30%, saving the world's peasants more than $9 billion per annum.[26]

8. **Advance the rights of women food producers:** Women account for 60 to 80% of peasant growers and produce 90% of food in Africa and about half of all food worldwide. Yet in sub-Saharan Africa, only 15% of landholders are women and they receive less than 10% of credit and 7% of extension services.[27] Policies that address gender inequalities could, conservatively, increase over yield by 2.5% to 4% and bring 100 million people out of hunger.[28]

9. **Diversify food processing and retailing**. Today, the largest supermarket oligopolies control 40-50% of the food market in Latin America, 10% in China, 30% in South Africa and 50% in Indonesia.[29] The leading 100 processors control 77% of global packaged foods and 10-11% of world retail food sales.[30] Peasant systems feed 70% of the world – including the most vulnerable.[31] Competition policies should eliminate oligopolistic practices. New policies must diversify consumer options, reduce the need for processing and support local food storage and distribution.

10. **Improve the North's Food/Energy Ratio to Match the South's:** Today, on average,

OECD states use up four kilocalories (kcal) of energy to produce one kcal of food whereas, in general, the global South takes one kcal of energy to produce one kcal of food. OECD government should consider incentives (including negative tax pressure) to bring the industrial food chain's energy consumption at least into alignment with peasant food production. This would amount to a massive saving in fossil fuels and greenhouse gas emissions.[32]

11. **Reduce freshwater waste in food and beverage processing industries.** Five global food and beverage corporations – Nestle, Danone, Unilever, Anheuser-Busch, and Coca-Cola consume enough water to meet the daily domestic needs of every person on the planet.[33] Today, it takes, for example, 12,000 L of water to produce and process one-half kilo of chocolate.[34] The water required to produce 65 million kg of ground beef – the amount recalled and destroyed due to food safety violations in the United States in 2008 – was equivalent to the water required to irrigate 100,000 hectares of dry land for one year.[35] Peasant production models that privilege local consumption waste little or no water. Policies must prioritize local consumption and heavily tax wasteful processing companies.

Policies to shrink agriculture's environmental footprint and improve health

12. **Improve health and reduce environmental damage.** Today, the average adult in an OECD country eats an unnecessary and unhealthy extra meal each day (roughly an extra 750 calories). About 25% of the energy and water – and the associated greenhouse gas produced – used in OECD countries goes to "waste food."[36] At least 50% of OECD adults are overweight or obese. Obesity costs OECD states almost $300 billion per year[37] – an amount that is more than enough to meet all of the Millennium Development Goals by 2015, with around $100 billion leftover.[38]

13. **Reduce OECD meat and dairy consumption.** According to UN estimates, demand for meat and dairy products will double by 2050. Per capita OECD meat consumption is 10 times that of the global South.[39] A 25% reduction in livestock product consumption worldwide would reduce our GHG emissions by 2.5%.[40]

14. **Eliminate waste and environmental devastation in the fisheries industry.** Today, industrial fish farming takes 6 tonnes of wild fish to produce 1 tonne of fishmeal and between 1.5 and 3 tonnes of meal to harvest 1 tonne of farmed salmon.[41] Peasant fishers and family fishponds recycle nutrients and have almost no waste. Policies must incorporate this waste into industrial fish farm taxes.

15. **Strengthen urban and peri-urban food systems.** Today, British consumers throw away 243 L of water per day in wasted food. This amounts to 6% of total UK water usage and one and a half times more than personal daily fresh water needs.[42] Today, 25 to 30% of fresh water – about 45 billion L – in urban areas is lost through leaky pipes costing municipalities $14 billion a year.[43] The urban water wasted through leaky pipes could provide the water needs of 200 million people or 4.5 million urban micro-gardens. If the 243 L of water lost each day from food thrown away were available to urban gardeners it

could produce 18,000 tomatoes per annum, 3,240 lettuces every 60 days, 900 cabbages every 90 days or 9,000 onions every 120 days.[44] Policies should promote urban agriculture (including its access to safe water) that will improve water efficiency, recycle wastes, and support nutrition.

Policies to encourage innovation and diversification in the food web

16. **Support *in situ* peasant conservation strategies.** There is general agreement that the adaptation of agriculture to climate change will depend upon the conservation and introduction of crop wild relatives. Current efforts, however, are only collecting 700 species. Peasants conserve 50-60,000 species of wild relatives. Their *in situ* conservation and community breeding must be supported.[45]

17. **Encourage breeding and production of underutilized crops.** Today, the industrial food chain concentrates on 150 species with almost all research going into 12 species.[46] The peasant food web breeds and nurtures 7,000 food crops, offering enormous potential to respond to climate change. Policies must strengthen their efforts to diversify the food web.

18. **Restructure research priorities to support peasant breeding.** Over the last half-century, industrial breeders have produced about 80,000 plant varieties (including 7,000 from international research centres). Almost 60% of private commercial breeding has been ornamental. Over the same period, peasants have contributed close to 2.1 million food and feed varieties.[47] Policies must surrender breeding direction to peasant organizations, duplicate gene bank accessions for peasant breeding and inter-farm exchange, and eliminate monopolistic regulations that inhibit innovation.

19. **Promote resilient livestock breeds and species diversity:** Today, 3-4 multinationals control breeding stock for each of the four key livestock animals (cattle, pigs, broiler chickens, laying hens and turkeys). In total, about 100 breeds account for almost all commercial meat and dairy production. Furthermore, three agribusinesses account for 43% of veterinary medicines and three others control 25% of industrial feeds world-wide. While the industrial food chain continues to narrow the range of species and breeds available to meet climate changes, peasants maintain 40 livestock species and 7,616 breeds that may otherwise become extinct.[48] Policies must support peasant conservation and breeding of these animals and the rights of traditional livestock keepers.

20. **Conserve and promote marine and freshwater fishing.** Today, industrial fisheries commercialize 363 species and the industrial system has wiped out 20% of all freshwater species while overfishing virtually all popular marine species. Peasant fishers protect and harvest more than 22,000 freshwater species alone.[49] Policies must strengthen support for peasant fishers.

The Road from Rio:

We have made progress if Rio…

- Calls for the full involvement of small-scale producers' organizations, and/or;
- Commends the CFS as the template for other UN bodies and treaties, and/or;
- Proposes a process/timetable for the continuation of IAASTD, and/or;
- Condemns land grabs and agrofuels, and/or;
- Criticizes "top-down," "technology-driven" industrial agriculture.

We have failed if Rio…

- Calls for further research on "intensive smallholder production," and/or;
- Champions "new technologies" to address climate change, and/or;
- Identifies CGIAR as the model for research, and/or;
- Proposes nothing more than "multi-stakeholder" initiatives or "public-private partnerships," and/or;
- Leaves opening for land grabs and/or agrofuels.

4. Conclusion

The months leading up to Rio+20 in June 2012 are a time of risk and opportunity. Current governance structures for sustainable development in the UN system suffer from a lack of coordination among institutions; a lack of effective representation for most governments; and an absence of involvement of civil society and social movements. Rio+20 offers a real opportunity to strengthen democracy and peoples' participation within the UN system, and to take three crucial steps forward: (1) establish a pathway for precautionary, inclusive technology evaluation; (2) ban geoengineering; (3) and commit to support small-scale peasant-led agriculture.

Table 1: Early Warnings without Early Listeners			
Early Warning	**Problem**	**Late Listening**	**Years Delayed**
1602	**Tobacco**[50]	1970s	>370
Early 1700s	**Caffeine**[51]	?	?
1866	**Fish stocks**	1970s	100
1896	**Radiation**	1928	32
1897	**Benzene**	1977	80
1898	**Asbestos**	1931	33
1899	**PCBs**	1972	73
1907	**CFCs**	1977	70
1938	**Halocarbons**	1997	59
1938	**DES**	1971	33
1945	**Antimicrobials**	>1970	>25
1952	**Sulphur dioxide**	1979	27
1954	**MTBE**	2000	46
1962	**DDT**	1969	7
1970	**TBT**	1982	12
1970	**Hormones**	1982	12
>1970	**BSE**	1996	>20
1980	**GMOs -**	2003	23
2002	**Nanoparticles**	>2003	?
Source: Adapted from *Late Lessons from Early Warnings*: *The Precautionary Principle 1896-2000*, Environmental Issues Report, EEA, 2001, with additional examples from ETC Group.			

ENDNOTES:

[1] Agenda 21, Chapter 34 took a holistic approach to technology transfer, underlining the importance of adequate information on environmentally sound technologies as well as improving access to them, strengthening South countries' technological capacities, information and choices. Governments agreed to enhance the transfer of technologies, to build capacity, to foster successful long-term partnerships, to revalorize indigenous knowledge, to foster public sector research, and to build capacity for technology assessment and to finance technology transfer. Virtually none of this has been done and the technology gap between North and South has continued to widen, while high-risk technologies enter the globalized marketplace with inadequate attention to their medium- and long-term social, economic and ecological impacts.

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[13] See, for example, the testimony of John Virgoe before the UK Parliamentary Committee on Science and Technology Committee in House of Commons, *The Regulation of Geoengineering*, Fifth report of session 2009-10, pp. EV5-EV6, 10 March 2010: http://www.publications.parliament.uk/pa/cm200910/cmselect/cmsctech/221/221.pdf.

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ETC Group is an international civil society organization (CSO), addressing the socioeconomic and ecological issues surrounding new technologies that could have an impact on the world's poorest and most vulnerable. We investigate ecological erosion (including the erosion of cultures and human rights); the development of new technologies (especially agricultural but also new technologies that work with genomics and matter); and we monitor global governance issues including corporate concentration and trade in technologies. We operate at the global political level. We work closely with partner civil society organizations and social movements, especially in Africa, Asia and Latin America.

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