

Synthetic Biology: The Response of the Commission of the (Catholic) Bishops' Conferences of the European Community

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Abstract: The Commission of the (Catholic) Bishops' Conferences of the European Community (COMECE) has issued an opinion on the ethics of synthetic biology (synbio). Examining synbio from religious and more general ethical perspectives, it examines synbio's potential pros and cons, as well as whether it is ethical in and of itself. Its conclusions mirror those of the ethical mainstream; namely, that synbio may present humanity with opportunities for both great advancement and great destruction. It suggests a prudent approach, and calls for regulation to be used to encourage positive outcomes while reducing the likelihood of negative ones.

Keywords: synthetic biology; synbio; God; Catholic Church; Christian; religion; ethics; Commission of the Bishops' Conferences of the European Community (COMECE)

Introduction

The Commission of the Bishops' Conferences of the European Community (COMECE)¹ have published an opinion on synthetic biology (synbio): *COMECE: Opinion of the Reflection Group on Bioethics on Synthetic Biology*.² COMECE largely consists of Catholic bishops from the 28 European Union member states, delegated by the national bishops' conferences of those states. Their headquarters is in Brussels, very close to the European Parliament. They engage with the EU. They also publish opinions on ethical issues relevant to the Church, to the EU and to society, in a number of fields, including bioethics. The bishops delegate such work to expert commissions.³

It is significant that a reasonably high-ranking ethical reflection group within the Catholic Church has issued an opinion on synbio. The Catholic Church is the world's largest religion, comprising approximately 17.8 percent of the world's population.⁴ Its views can, to an extent, affect many of the world's cultures. Synbio seems, by its mere existence, to invite the world religions to engage with it, either positively or negatively. In the words of a Church of Scotland (Presbyterian) report: "the philosophical/anthropological connotations of synthetic biology... may be seen to be 'treading on religious toes.'"⁵ Some secular writers have made the same connection; Peter Singer, for example, observed that "the scientists at the J. Craig Venter Institute expected to be told that they were 'playing God,' and they were not disappointed. Yes, if one believes that life was created by God, then this comes as close to 'playing God' as humans have come so far."⁶ Synbio, as with all human activity, does not take place in a vacuum. The attitude of the surrounding cultures, including their religions, is likely to play a significant role in whether or not synbio flourishes.

COMECE begin their reflection by asking a fundamental religious question: whether synbio impinges on God's role, reflecting human hubris. It rejects that

view, seeing synbio as part of normal human creativity. Overall, COMECE's view on synbio could be described as cautiously optimistic. They take a balanced approach, being aware of synbio's potential benefits, while not being naïve to its probable dangers.

Summary of the *Opinion*

The *Opinion of the Reflection Group on Bioethics on Synthetic Biology* is divided into three chapters, followed by a conclusion. The first chapter, titled "A Rapidly Expanding Domain," introduces and describes synbio; the second, "Objections in Principle or A Call to Responsibility?" discusses various ethical issues, under three subheadings: "A rebellion against the sovereignty of God?;" "An arbitrary manipulation of life?;" and "An urgent appeal for responsibility." The third, "An Essential Framework for Practices," deals with the issues of safety and security, international trade and justice, patents, public information and dialogue between science and society, and application to human beings. In constructing its arguments, the *Opinion* quotes liberally from relevant Catholic Church teachings and also from several EU and other government-level documents; it applies conclusions from both, along with more general ethical approaches, to the issue of synbio ethics. The document is short; it does not compare, in terms of breadth and depth, with the various other major reports (government, charitable, private) currently in circulation.

The *Opinion* begins, in chapter 1, by attempting to define synbio. It quotes from a report by the European Group on Ethics in Science and New Technologies in the European Commission (EGE), which is an advisory group to the European Commission. This report, *Ethics of Synthetic Biology*,⁷ states that synbio is difficult to define, and that any definition may change over time.⁸ Nevertheless, the EGE then describes what a definition of synbio should include, and the COMECE *Opinion* adopts that, quoting from the EGE that synbio is the attempt to create artificial life forms; or to re-engineer existing lifeforms.⁹ Also, any definition should include the research areas of biological toolkits; attempts to design minimal genomes, cells, or organisms; and building biological systems that are partly or totally artificial/synthetic.¹⁰ The *Opinion* also notes that synbio is primarily an engineering discipline, using the techniques of disciplines such as computer science and mathematical modelling, applied to biology, to design synthetic parts or organisms. On this it quotes, for emphasis, from another definition, that of the European research consortium *Synbiology*: "... [synbio] is determined on the intentional design of artificial biological systems, rather than on the understanding of natural biology."¹¹ COMECE's authors then briefly discuss a number of topics in synbio research: top down versus bottom up approaches to building synbio systems, *Synthia*, and minimal cells.¹² This introductory section is quite short; it lacks detail and does not mention several important research areas. It gives an "impressionistic" (in the popular sense of the word) overview of synbio, rather than an authoritative account.

The *Opinion* then explains some potential and current uses of synbio, giving a few examples, in areas such as agriculture, the environment, health, energy, and materials.¹³ It quotes from France's Parliamentary Office for Evaluation of Scientific and Technological Options (OPECST) report, *Les Enjeux de la Biologie de Synthèse [Issues in Synthetic Biology]*, which observes that synbio may generate a second industrial revolution, affecting areas such as medicine, agriculture, the

environment, energy, and industry, having the potential to cure disease and help provide solutions to problems such as climate change. It warns, too, against “overhyped promises.”¹⁴

COMECE’s authors observe that synbio’s progress is likely to depend on a variety of factors. The feasibility of the science is one, obviously, as is risk assessment, but other factors may influence decisions about the field. These may include the outcomes of philosophical, ethical, and religious debates, as well as the public’s acceptance or rejection of the field.¹⁵

Having laid this groundwork, chapter 2 raises various concerns about synbio. It begins by posing some leading questions, negatively phrased: “are we not on a collision course with objections of principle?; Can mankind indeed alter the universe which has been entrusted to it, can it make new forms of life appear? Is it not jeopardising the universe? Above all, is it not a manifestation of excess and of an unacceptable pretension? Is it not usurping the place of the Creator?”¹⁶

It goes on to answer, and largely reject, such objections. Regarding the “playing God,” argument, it states, referring in particular to accusations against Craig Venter and his work on Synthia: “Clearly Craig Venter has not created life. The label of overweening megalomania would be attached to anybody who regarded himself as a creator in the strong sense that this term has in a religious context. Craig Venter has obtained a new life form, but to do that he has only exploited, after long and costly efforts, the natural properties of a bacterium which certainly did not owe its existence to him!”¹⁷

Regarding whether humanity has the right to modify life, in this or other ways, the *Opinion* notes that it has been doing this in agriculture for a long time. It quotes from the *Compendium of the Social Doctrine of the Church* (a summary of the Church’s official teachings on “social” issues, primarily the economy and bioethics):

the Christian vision of nature makes a positive judgment on the acceptability of human intervention in nature, which also includes other living beings, and at the same time makes a strong appeal for responsibility. In effect, nature is not a sacred or divine reality that man must leave alone. Rather, it is a gift offered by the Creator to the human community, entrusted to the intelligence and moral responsibility of men and women. For this reason the human person does not commit an illicit act when, out of respect for the order, beauty and usefulness of individual living beings and their function in the ecosystem, he intervenes by modifying some of their characteristics or properties.¹⁸

To this, COMECE’s authors add: “The human person is ... invited to behave as God’s associate, meaning that he reaches a heightened sense of his responsibility at the moment when he is altering the world that has been entrusted to him.”¹⁹ They also quote Pope Francis, directly quoting John Paul II: “Many recent discoveries have brought undeniable benefits to humanity. Indeed, they demonstrate the nobility of the human vocation to participate responsibly in God’s creative action in the world.”²⁰

They also urge prudence, however. They observe that humanity should not damage nature by its interventions. Humanity can develop nature’s potential, but not tyrannize it. Quoting again from the *Compendium*: “mankind must not “make arbitrary use of the earth, subjecting it without restraint to his will, as though it

did not have its own requisites and a prior God-given purpose, which man can indeed develop but must not betray. When he acts in this way, instead of carrying out his role as a co-operator with God in the work of creation, man sets himself up in place of God and thus ends up provoking a rebellion on the part of nature, which is more tyrannized than governed by him."²¹

The *Opinion* quotes the *Compendium* again to note that proper risk-benefit analysis should always be undertaken in such research. The relevant professionals should not act "lightly or irresponsibly;"²² it would be "unacceptable" to do so.²³ Two principles should guide this type of research in Catholic thought: namely, life should be respected; and the creation has integrity.²⁴ Therefore, new technologies should not threaten human health or the environment.²⁵ Environmental protection should extend into the future. The world's biodiversity should be protected; the authors refer to the *Cartagena Protocol on Biosafety* here.^{26,27} Biotechnologies should always be used in ethical ways, guided by solidarity and justice, enhancing the social, economic and social life of humanity. Scientific knowledge should be shared, trade should be fair, and developing countries should have access to the technologies.²⁸

Risks may extend beyond the environment, to the economy and society. On this, the authors quote Pope Francis on genetic modification, from his 2015 encyclical on the environment, *Laudato Si*:

it is difficult to make a general judgement about genetic modification (GM), whether vegetable or animal, medical or agricultural, since these vary greatly among themselves and call for specific considerations. The risks involved are not always due to the techniques used, but rather to their improper or excessive application (...) Although no conclusive proof exists that GM cereals may be harmful to human beings, and in some regions their use has brought about economic growth which has helped to resolve problems, there remain a number of significant difficulties which should not be underestimated. In many places, following the introduction of these crops, productive land is concentrated in the hands of a few owners (...) The expansion of these crops has the effect of destroying the complex network of ecosystems, diminishing the diversity of production and affecting regional economies, now and in the future. In various countries, we see an expansion of oligopolies for the production of cereals and other products needed for their cultivation. This dependency would be aggravated were the production of infertile seeds to be considered; the effect would be to force farmers to purchase them from larger producers.²⁹

The third chapter, "An Essential Framework for Practices," begins by observing that synbio has "huge potential for development that will probably result in the acquisition of immense power of manipulation of living organisms." As a result, it is attracting great interest from some business and political leaders. The authors note that it is hard to predict the course of synbio, and of the ethical and other issues that it may give rise to. They recommend precise regulations to govern the science.³⁰

Regarding safety and security, they state that synbio research and its products should be safe. This includes human safety (which encompasses workers' rights), and protection of the environment. They briefly describe the biosecurity issue,

focusing on the fact that amateur biohackers can create synbio products in home laboratories. They mention the bioweapons threat, and the potential for bioterrorism. They recommend deep reflection on governance, risk assessment, and monitoring, by the EU, its member states, and the international community. They also recommend the development of ethical guidelines within the scientific communities themselves. They note that the EU's commitment to freedom of research does not override the common good.

Regarding international trade and justice, the *Opinion* notes that synbio may generate great prosperity for technologically advanced countries; obviously a positive development. However, it also notes that it could cause the technology and prosperity gap to increase between advanced and developing countries, both within and outside of the EU. The *Opinion* quotes, with approval, the EGE Group's concern about this.³¹ It adds a quote from Pope John Paul II's 1991 encyclical, *Centesimus Annus*, which calls for the breaking down of barriers, including monopolies that inhibit the development of nations and individuals.³²

Patents are then discussed. This begins with a longish quote from another COMECE *Opinion*, *Patentability of Human Stem Cells*.³³ That document approves, in the most general terms, the patenting of biotech products. Significant investment may be needed to bring such products to fruition; and inventors should benefit from their inventions. Patenting also allows scientific knowledge to be disseminated. However, limits can be placed on intellectual property (IP) benefits; for ethical reasons, or if the common good requires it.

COMECE note that serious questions arise in biotech, particularly the issue of what should be patentable.³⁴ They ask whether patents should be granted on biological material. They have adopted *European Directive 98/44/EC of 6 July 1998's* definition of biological material: "any material containing genetic information and capable of reproducing itself or being reproduced in a biological system."³⁵ Traditionally, patents have been granted on inert material. Biological material that can reproduce itself raises new issues, because although there is the issue of invention, as before, when the invention incorporates living material, patenting it may involve "the appropriation of elements of biological organisms by specific industrial actors or even the claim of a copyright on the living matter itself."³⁶ The authors note that "stiff opposition" will arise to such claims;³⁷ as, indeed, it has. They observe that the European Patent Office allows a broad scope on biotech patents; patents can encompass a wide variety of biological functions. This may inhibit scientific research, and also reduce its applicability to developing countries.³⁸

The *Opinion's* discussion on patents is brief, and raises questions for discussion rather than attempting to answer them. The issue of synbio patents is a complex one:³⁹ synbio's unique features of high level invention on a multiplicity of living, interlinked, evolving materials, which may combine with each other and the rest of nature in unknowable ways, combining with advances in electronics, robotics, and computing, including artificial intelligence, may require a rethink of the intellectual foundations of patent law. Biological inventions build upon nature, but cannot work without it. To describe such creations as inventions and apply current IP law to them is, arguably, to attempt to fit a square peg into a round hole. The IP law community itself has yet to resolve these issues. It has been suggested that new thinking in IP law may be required for synthetic biology.⁴⁰ For example, the European Patent Office has published a detailed report that suggests possible ways in which IP laws may change over the next decades.⁴¹ A French government

report has also suggested possible evolution of IP law.⁴² It is a challenging topic, made more so by the fact that it is impossible to predict the directions that synbio will take. Could the Church engage with the IP law and synbio communities, to offer guidance drawn from its ethical teaching?

The *Opinion* then discusses the need for wide-ranging societal debate on synbio, evaluating benefits versus risks, something that has not taken place up to now.⁴³ It quotes Pope Francis on public debate on biological innovation in general:

A broad, responsible scientific and social debate needs to take place, one capable of considering all the available information and of calling things by their name. It sometimes happens that complete information is not put on the table; a selection is made on the basis of particular interests, be they politico-economic or ideological. This makes it difficult to reach a balanced and prudent judgement on different questions, one which takes into account all the pertinent variables. Discussions are needed in which all those directly or indirectly affected (farmers, consumers, civil authorities, scientists, seed producers, people living near fumigated fields, and others) can make known their problems and concerns, and have access to adequate and reliable information in order to make decisions for the common good, present and future.⁴⁴

The final topic for discussion is the applicability of synbio to human beings: "Insofar as it evolves, synthetic biology will obviously have profound repercussions on human beings and their life styles. However, we can expect that questions will emerge very soon about the direct application on the human body of inventions regarding the most diverse biological systems."⁴⁵ COMECE notes that synbio has the potential to greatly advance medicine, giving the example that alterations to the human genome have cured children who may otherwise have died or lived lives of great suffering.⁴⁶ They also note dangers, giving the example of somatic versus germinal gene therapy. Somatic gene therapy is not transmitted to future generations; germinal is, and could transmit unknown consequences to future generations. They state that physicians rejected germinal therapy until recently; and that this should be a guideline for both legal and ethical deliberation, and enforced by regulation. Synbio's output should serve human dignity, and be applied to cure illness and disability. Regarding synbio's application to a Humanity 2.0 or singularity scenario, the *Opinion* restates church teaching on the issue, observing that human dignity requires "resisting any dreams of 'enhanced humanity,'"⁴⁷ because humanity is made in God's image in the Church's view.

The Conclusion to the *Opinion* briefly restates and summarizes the foregoing. Ultimately, it concludes that synbio offers both great potential advances for human civilization, and great threats to it. It expresses the hope that synbio will be used in a beneficial manner, and that negative uses should be prevented. Synbio and its potential applications should be studied in detail, so as to guide its development on a positive course. Also, benefits should accrue to both First World and developing countries; there should be collaboration between both. COMECE suggest that scientists should engage with synbio's ethics, and be willing to impose limitations on their research, as has previously happened in bioscience research.⁴⁸ They also recommend the establishment of governance structures. They encourage public debate. They recommend dialogue among scientists, public authorities, and the public, saying that the latter should play a meaningful role in the discussion and

decisionmaking. They conclude that synbio is not “playing God.” It should be directed in a way that respects the Creation; and humanity’s common good.⁴⁹

Discussion

COMECE’s document is a useful addition to the synbio ethics literature. It is short, and largely written at the level of overview. It offers the insights of a significant “ethical reflection group” within the world’s largest religion; one that has no degree of self-interest in the debates. It may be seen as an interim Catholic church opinion on synbio.⁵⁰ Previous informal statements were made by high-ranking church officials in 2010, after Synthia’s development; they’re in agreement with COMECE’s analysis.⁵¹ A more senior and definitive opinion, a formal church teaching, may be issued in due course by a higher church authority; possibly by a group such as the Vatican’s Congregation for the Doctrine of the Faith (CDF), the church’s main authority for doctrinal teaching and defense.

COMECE’s ethical presuppositions on the relevant issues can be summarized in the relevant parts of the *Catechism of the Catholic Church*, a summary of the Church’s faith: “Basic scientific research, as well as applied research, is a significant expression of man’s dominion over creation. Science and technology are precious resources when placed at the service of man and promote his integral development for the benefit of all.”⁵²

Scientific research can never be separated from morality in the Church’s view:

It is an illusion to claim moral neutrality in scientific research and its applications. On the other hand, guiding principles cannot be inferred from simple technical efficiency, or from the usefulness accruing to some at the expense of others or, even worse, from prevailing ideologies. Science and technology by their very nature require unconditional respect for fundamental moral criteria. They must be at the service of the human person, of his inalienable rights, of his true and integral good, in conformity with the plan and the will of God.⁵³

The church approves of scientific progress as long as it is ordered toward moral ends. It contributes to that progress, in so far as it can, by educating students in the sciences, in its schools and universities. It also operates a small number of scientific research institutes itself. Coming from this intellectual and spiritual context, the COMECE *Opinion* sees synbio as a natural progression in scientific knowledge, something to be encouraged as long as it is oriented toward the good; “good” being defined as being beneficial toward humanity and all of nature, and in harmony with God’s design.

COMECE’s positive yet prudent, cautious attitude toward synbio mirrors that of other mainstream Christian groups. The first Christian group to issue a comprehensive report on synbio was the Church of Scotland, in 2010. (I noticed their presence at several synbio conferences in the few years preceding.) Their report discussed, among other issues, the science, the potential applications, and the pros and cons, from within a mainstream Christian perspective. Their conclusions were essentially positive, while warning of potential negatives:

If appropriate legislation and effective control could make sure that all potential risks were eliminated, or at least avoided, there is no compelling reason to stop or ban synthetic biology. Everybody, including the Christian

world, could welcome this scientific innovation. Eliminating human suffering, protecting the environment, promoting general well-being and advancing scientific knowledge using reason and human ingenuity are goals in harmony with Christian teaching. God has endowed human nature with mental and intellectual capacities. It is our responsibility to use the divine gifts for the benefit of humanity, and of nature as a whole.⁵⁴

and

Despite some protestations to the contrary, synthetic biology does not put humanity on a par with God: our creatureliness remains, our undoubted creativity in such areas notwithstanding. Much of what is highlighted illustrates afresh the need for all aspects of human endeavour to be carried out in an appropriate ethical framework, and the responsibility of the church to engage constructively with those seeking to utilise science and technology in a responsible manner.⁵⁵

Most religious groupings do not issue formal teachings on bioethics, as does the Catholic church, but there have been informal statements from mainstream representatives of various world religions—Jewish, Protestant, Muslim, Hindu, and Buddhist—that suggest that a safe, ethical synbio does not pose any theological problems.^{56,57,58}

There are of course, exceptions. Some fundamentalist Christians, for example, see synbio as essentially sacrilegious, an intrusion into God’s role; they oppose it passionately. Some of their counterparts in the non-Christian religions may feel the same. Although fundamentalists are a small minority among Christians, they are influential in the United States, the world center of synbio research. The rise of synbio could increase the heat in the culture wars there.^{59,60}

As mentioned, COMECE’s discussions and conclusions closely reflect those of mainstream ethicists, because in general, the church’s ethical output aligns with the ethical mainstream (there are a few notable exceptions, which hardly need mentioning).⁶¹ Mainstream ethics has been greatly influenced by the Church’s philosophical shaping of Western thought since the church’s foundation.

Notes

1. Pronounced “com-ay-say,” the acronym stands for *Commissio Episcopatum Communitatis Europaeae*; in Latin, the official language of the Church. Their website is www.comece.eu (last accessed 30 July 2016).
2. COMECE. Opinion of the Reflection Group on Bioethics on Synthetic Biology. Brussels: COMECE, 2016; available at http://www.comece.eu/dl/qsmjKJKooNmJqx4KJK/SyntheticBIO_EN.pdf (last accessed 30 July 2016).
3. COMECE: Who We Are; available at <http://www.comece.eu/site/en/whowere> (last accessed 30 July 2016).
4. According to the Vatican yearbook, *Annuario Pontificio 2016*, the Catholic population is growing at a faster rate than the rest, and currently stands at approximately 1,270,000,000. See Esteves JO. Vatican statistics report increase in baptized Catholics worldwide. *National Catholic Reporter*, March 7, 2016; available at <https://www.ncronline.org/news/vatican/vatican-statistics-report-increase-baptized-catholics-worldwide> (last accessed 30 July 2016).
5. Church of Scotland, Church and Society Council. *Synthetic Biology*. Edinburgh: Church of Scotland; 2010; §11.4.6; available at http://www.churchofscotland.org.uk/__data/assets/pdf_file/0004/3793/synthetic_biology_report.pdf (last accessed 30 July 2016).
6. Singer P. Scientists playing God will save lives. *The Guardian*, June 13, 2010; available at <http://www.guardian.co.uk/commentisfree/2010/jun/13/science-playing-god-climate-change> (last accessed 30 July 2016).

7. European Group on Ethics in Science and New Technologies in the European Commission (EGE). *Ethics of Synthetic Biology*, Opinion No. 25, November 2009; available at https://www.erasynbio.eu/lw_resource/datapool/_items/item_15/ege__opinion25_en.pdf (last accessed July 30, 2016).
8. See note 7, European Group on Ethics in Science and New Technologies in the European Commission 2009, at 1.3.
9. See note 2, COMECE 2016, at 3.
10. See note 2, COMECE 2016, at 3.
11. Synbiology. An Analysis of Synthetic Biology Research in Europe and North America. Final Report on Analysis of Synthetic Biology Sector, September 2006; available at <http://www2.spi.pt/synbiology/documents/news/D11%20-%20Final%20Report.pdf> (last accessed 30 July 2016); quoted in COMECE; see note 2, COMECE 2016, at 4.
12. See note 2, COMECE 2016, at 4–5.
13. See note 2, COMECE 2016, at 5.
14. Parliamentary Office for Evaluation of Scientific and Technological Options Presentation, OPECST, France. *Les Enjeux de la Biologie de Synthèse*, 2012, at 199–200; available at <http://www.assemblee-nationale.fr/13/pdf/rap-off/i4354-tii.pdf> (last accessed 23 July 2016); quoted in COMECE; see note 2, COMECE 2016, at 6.
15. See note 2, COMECE 2016, at 6.
16. See note 2, COMECE 2016, at 7.
17. See note 2, COMECE 2016, at 7.
18. Pontifical Council for Justice and Peace. *Compendium of the Social Doctrine of the Church*, Vatican City: Libreria Editrice Vaticana; 2004; §460; available at http://www.vatican.va/roman_curia/pontifical_councils/justpeace/documents/rc_pc_justpeace_doc_20060526_compendio-dott-soc_en.html#Lenvironnement,%20un%20bien%20collectif (last accessed 30 July 2016). Quoted in COMECE; see note 2, COMECE 2016, at 8.
19. See note 2, COMECE 2016, at 8.
20. Pope John-Paul II. *Message for World Day for Peace*; January 1, 1990; §6. This passage is quoted by Pope Francis in his Encyclical *Laudato Si*, May 24, 2015; in COMECE; see note 2, COMECE 2016, at 8.
21. See note 18, Pontifical Council for Justice and Peace 2004, §473; quoted in COMECE; see note 2, COMECE 2016, at 8.
22. See note 18, Pontifical Council for Justice and Peace 2004, §473; quoted in COMECE; see note 2, COMECE 2016, at 8.
23. See note 2, COMECE 2016, at 8.
24. See note 18, Pontifical Council for Justice and Peace 2004, §466; quoted in COMECE; see note 2, COMECE 2016, at 9.
25. See note 2, COMECE 2016, at 9.
26. Secretariat on the Convention on Biological Diversity. *Cartagena Protocol on Biosafety to the Convention on Biological Diversity*. Montreal: Secretariat on the Convention on Biological Diversity; 2000; available at <https://www.cbd.int/doc/legal/cartagena-protocol-en.pdf> (last accessed 30 July 2016); in COMECE; see note 2, COMECE 2016, at 9.
27. See note 2, COMECE 2016, at 9.
28. See note 2, COMECE 2016, at 9.
29. Pope Francis. *Laudato Si*, 2015; §133 and §134; available at http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html (last accessed 30 July 2106); quoted in COMECE; see note 2, COMECE 2016, at 9.
30. See note 2; COMECE 2016, at 10.
31. See note 7, European Group on Ethics in Science and New Technologies in the European Commission 2009, at 4.5.2; quoted in COMECE; see note 2, COMECE 2016, at 12.
32. Pope John Paul II. *Centesimus Annus*, 1991; quoted in COMECE; See note 2, COMECE 2016, at 12.
33. COMECE Bioethics Reflexion Group. Patentability of human stem cells. *Science et Ethique*, 2008, at 29; available at www.comece.eu/dl/ppmuJKJOMOKJqx4KJK/20080601PUBIOVOL1_EN.pdf (last accessed 30 July 2016).
34. See note 2, COMECE 2016, at 12–3.
35. Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998, Article 2; in COMECE; see note 2, COMECE 2016, at 13.
36. See note 2, COMECE 2016, at 13.
37. See note 2, COMECE 2016, at 13.
38. See note 2, COMECE 2016, at 14

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43. See note 2, COMECE 2016, 14.
44. Pope Francis. *Laudato Si*, May 24, 2015; §135; available at http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html (last accessed 30 July 2016).
45. See note 2, COMECE 2016, at 14.
46. See note 2, COMECE 2016, at 15.
47. See note 2, COMECE 2016, at 15.
48. For example, genetic engineers imposed a moratorium on genetic engineering research, until it could be proven safe; at the Asilomar Conference. More recently, CRISPR researchers imposed a moratorium on its application in clinical research; see Wade N. Scientists seek moratorium on edits to human genome that could be inherited. *New York Times*, December 3, 2015; available at <http://www.nytimes.com/2015/12/04/science/crispr-cas9-human-genome-editing-moratorium.html> (last accessed 10 October 2016).
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58. Glick, S. Synthetic biology: a Jewish view. *Perspectives in Biology and Medicine* 2012;55:571–80.
59. See note 50, Heavey 2011.
60. Not all Catholics will agree with the Church's position. For example, an interesting opposing article (not peer-reviewed and with several factual errors) is Mejia DE. The moral and ethical concerns of synthetic biology: the reasons why we should stop. *Seton Hall Law School Student Scholarship* 2016, at 767; available at http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1761&context=student_scholarship (last accessed 30 July 2016). It should be noted that the Church's teaching bodies have religious authority for Catholics, and represent the Church's position to all. Other Catholics do not have authority to speak for the Church, but are required to follow their conscience, even if it leads them to disagree with certain Church teachings; see note 50, Heavey 2011.
61. See note 50, Heavey 2011.