

The paper published in Frontiers in Conservation Science on January 13<sup>th</sup> 2022<sup>1</sup> lays out in stark terms the challenges we face in 1) understanding the full scope of the ecological breakdown we are living through and facing 2) discussing whether we have the political systems that enable the choices to be made to contrast this breakdown and 3) calling upon scientists to have the courage to speak out now, before it is too late.

For this writer, three issues are critical:

- 1) Understanding the role of technologies
- 2) The correct use of financial resources
- 3) The political decision-making processes

As this seminar regards the circular economy, biorefining and industrial symbiosis and the use of biomass in driving the ecological transition I will focus my attention here.

Firstly technologies.

Whilst not being a scientist I have had the pleasure to be involved in several EU funded projects which aim to enhance the recovery of biomass wastes for their transformation into new materials.

The first of these which ended in which 2019 is the Res Urbis project ([www.res-urbis.eu](http://www.res-urbis.eu)) led by the University La Sapienza in Rome, experimented the use of sewage sludge and food waste as a feedstock for biorefining into PHA, a compostable and biodegradable plastic. The pilot plant showed that this is possible and given the potential market pull for PHA, also economically viable. Funding applications for full scale demonstrator plants have been made but have not yet been accepted. Meanwhile the experiences made are being lost.

The second, still in course, is the Usable Packaging project, ([www.usable-packaging.eu](http://www.usable-packaging.eu)) which also experiments the production of PHA but from another feedstock, the by-products from the production of wine and pasta and biscuits. The project is trying to demonstrate that the biorefining of such feedstocks is suitable for the large scale production of PHA and that this can be used both for blowing and moulding. Again, given potential market pull the long term economic viability of full scale production of PHA from these feedstocks is deemed possible.

The third is a company I assist, CO2BIOCLEAR, (<https://co2bioclean.com/>) which is situated in Germany, has been awarded a €2 million grant from the European Innovation Fund with another €4 equity investment capital to build a demonstrator that will produce PHA using waste CO2 from biogas installations. This project will commence in 2022.

All three are perfect examples of industrial symbiosis and circular bioeconomy, re-using what would otherwise have been wastes, or an environmental burden, as feedstocks for

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<sup>1</sup> <https://www.frontiersin.org/articles/10.3389/fcsc.2020.615419/full>

production that, with its end product, completes the biological carbon cycle through compostability and return to soil.

Composting, differing from the production of bioenergies/biogasses from the use of biowastes, is for this writer as important as energy/gas production. Our soils globally face long term loss of organic carbon and top soils in most geographies which the application of compost can help mitigate, as well as sinking organic carbon into soil. Whilst the use of biomasses to produce energy through anaerobic digestion is an important contributor to reduction of GHG emissions, it is not enough- the replenishment of organic carbon in soils is equally as vital. Hence this paper talks about compostability of materials as a driver for restoring ecological imbalances related to soil health. <sup>2</sup>

To conclude on technology, I firmly believe we do not face serious technological gaps in reducing the impacts of the ecological challenges around energy and pollution and that the circular bioeconomy approach, emphasising the importance of soil as a carbon sink, is part of those solutions.

Secondly, finance

The issues we face in rolling out such circular, bioeconomy, industrial symbiosis technologies are not around whether the technology functions or not, but around the economics, ie whether the scale can be achieved to make enough product to penetrate markets and *change them*. In the same ways electric cars changed the motor industry, bio-based materials made from renewable and formerly waste resources, need to be at a sufficient scale to change the paradigm of plastics. Currently they are not at scale and do not receive large scale investor financing. For example, fossil fuel based plastic production is at a scale of 200:1 compared to bio-based, compostable plastics.<sup>3</sup> Much of such production derives from fossil sources which enjoy financial subsidies from tax payers<sup>4</sup> and increasingly from coal in Asia<sup>5</sup>. No subsidies are given to the use of bio-based sources to produce equivalent materials.

Whilst funding for the research into such materials is considerable, (see the CBEJU<sup>6</sup>, previously the BBI JU, Horizon programmes in the EU as examples) the transition of these technologies from research projects into industrial production happens in an insignificant number of cases. The research closes, no further funding becomes available for demonstrator plants, the scientists go on to study something else for which they can find research funding.<sup>7</sup>

If we believe, as I do, that the use of renewable resources, especially waste derived, to produce materials that can be returned to soil as organic carbon is an ecologically valuable

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<sup>2</sup> See for example <https://www.iswa.org/biological-treatment-of-waste/?v=79cba1185463>

<sup>3</sup> <https://www.european-bioplastics.org/market/>

<sup>4</sup> <https://www.eesi.org/papers/view/fact-sheet-fossil-fuel-subsidies-a-closer-look-at-tax-breaks-and-societal-costs>

<sup>5</sup> <https://www.nature.com/articles/d41586-021-03613-0>

<sup>6</sup> <https://www.bbi.europa.eu/projects>

<sup>7</sup> <https://www.intereconomics.eu/contents/year/2015/number/1/article/the-impact-of-horizon-2020-on-innovation-in-europe.html>

enterprise, we have to search for the barriers preventing this happening at a larger scale and overcome them.

Finance still flows to climate endangering activities at an enormous rate. Just three months after the solemn declarations made at COP26 in which some 21 countries vowed to stop financing fossil fuel development<sup>8</sup>, we find that all the major finance houses as well as the oil majors and many Governments, are pouring billions into financing and subsidising fossil fuel production.<sup>9</sup> We find that oil majors, now awash with money, instead of investing those profits into the production of renewables, are buying back shares to keep the pension funds and investors happy<sup>10</sup>.

This leads us to the political decision-making process, or policies.

In the context of using bio-based resources to make materials such as plastics (or even energy), there are several key players opposing development; notably, the oil/gas companies whose feedstocks lead directly into chemical and polymer production; several multinational FMCG companies who do not want to face the extra costs of using alternative materials for (for example) their packaging; part of the waste industry which privileges the incineration of wastes over them being composted (it is more profitable and waste can be collected mixed rather than separately); some NGOs<sup>11</sup> whose opposition to substituting plastics with any other material borders upon the fanatical, and therefore leads to opposition to any alternatives; those representing the multinational, corporate structures dominating agriculture who want market forces (controlled by them) to determine outcomes in the food industry. Recent opposition to the EU Soil Strategy is a demonstration.<sup>12</sup>

There is, in the EU, a perverse alliance therefore between associations claiming to represent the public interest, (the NGOs) and associations representing multinational, corporate interests such as the fossil fuel, plastics, major agri-corporations and consumer facing industries.

As a result the Commission is itself confused and this confusion is manifested through policies such as the SUP<sup>13</sup> which includes a blanket ban on materials that are bio-based and compostable in those banned applications, defining even 100% renewable plastics such as PHA as the equivalent of any other plastic (see the Italian case<sup>14</sup>); in the consultations

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<sup>8</sup> <https://www.reuters.com/business/cop/19-countries-plan-cop26-deal-end-financing-fossil-fuels-abroad-sources-2021-11-03/>

<sup>9</sup> <https://www.theguardian.com/business/2022/feb/11/more-cash-than-we-know-what-to-do-with-oil-and-gas-companies-report-bumper-profits>

<sup>10</sup> <https://fortune.com/2022/02/10/big-oil-exxonmobil-chevron-shell-bp-total-green-investment-energy-transition-dividends-buybacks/>

<sup>11</sup> <https://rethinkplasticalliance.eu/>

<sup>12</sup> <https://www.euractiv.com/section/agriculture-food/news/soils-to-receive-same-legal-status-as-air-water-in-first-eu-wide-soil-health-law/>

<sup>13</sup> [https://ec.europa.eu/environment/topics/plastics/single-use-plastics\\_en](https://ec.europa.eu/environment/topics/plastics/single-use-plastics_en)

<sup>14</sup> [https://www.euractiv.com/section/politics/short\\_news/italy-not-happy-with-eu-guidelines-on-single-use-plastics-ban/](https://www.euractiv.com/section/politics/short_news/italy-not-happy-with-eu-guidelines-on-single-use-plastics-ban/)

launched on compostable plastics<sup>15</sup> (in course) in which the implicit accusation is that compostable plastics are negative because they do not biodegrade in the marine environment, a claim which producers of compostable plastics have never made; and in the upcoming revisions of the Waste Framework Directive<sup>16</sup> and (later this year) the PPWD<sup>17</sup> in which the role of compostable materials will be undermined. The same, identical issues are faced in the UK.

In these contexts, in the EU, it would take a courageous private investor to put capital into a start up like CO2BIOCLEAN.

Policy changes to enable investments at a large scale into circular, bioeconomy activities that have a regenerative impact upon soils and build upon industrial symbiosis using wastes for new materials, are heavily opposed by those that benefit from the linear economy. The Circularity Gap report, which is now in its fifth edition<sup>18</sup>, charts the slowly diminishing level of economic circularity in major economies which are today, according to the report, just 8.6% circular. Of the 500 billion tons of raw materials we consume this year, 43 billion will be recovered and reused with the rest ending up in the global commons.

Policy instruments available today do not yet direct investments away from such ecologically damaging activities into circularity. They do not take into account the externalities, the ecological damage which such activities entail. Carbon pricing is a step but it needs to be universal; taxes on materials is another, also requiring universality; creating border mechanisms to price in carbon on imports is another but extremely controversial; changing diets away from meat (difficult); generating heat with renewable fuels, long term; scaling up biobased industrial production also long term. And all this while avoiding forest destruction and enhancing biodiversity.

Take two simple examples:

- 1) it is still cheaper to mine gold from the earth than from used electronics where the concentrations are far higher and easier to access.
- 2) We collect and recycle into nutrients and energy just 2% of the global volumes of biowastes we produce, 100 billion tons. It is cheaper to dump them with resulting emissions of methane and Co2 than it is to convert them.<sup>19</sup>

## Conclusion

Whilst having the technologies to drive industrial symbiosis in the field of the circular bioeconomy is encouraging, and capable of becoming industrial scale enterprises in the next

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<sup>15</sup> [https://ec.europa.eu/environment/news/public-consultation-biobased-biodegradable-and-compostable-plastics-2022-01-18\\_en](https://ec.europa.eu/environment/news/public-consultation-biobased-biodegradable-and-compostable-plastics-2022-01-18_en)

<sup>16</sup> [https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13225-Impatto-ambientale-della-gestione-dei-rifiuti-revisione-del-quadro-dell-UE-in-materia-di-rifiuti/addFeedback\\_en?p\\_id=27911126](https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13225-Impatto-ambientale-della-gestione-dei-rifiuti-revisione-del-quadro-dell-UE-in-materia-di-rifiuti/addFeedback_en?p_id=27911126)

<sup>17</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01994L0062-20150526>

<sup>18</sup> <https://www.circularity-gap.world/2022>

<sup>19</sup> <https://www.worldbiogasassociation.org/global-potential-of-biogas/>

years, finance will not flow to those industries unless the policy landscape identifies and encourages them as being part of the future of the European economy.

This is because the weight and political power of industries with entrenched interests is such that scaling up of these enterprises will not be possible without Government direction. Strong Governments working in the public and not the private interest, supported by competent civil servants, are therefore key to enabling the ecological transition. Innovative industries, research and civil society alone are not enough, as the paper cited in the first line makes abundantly clear.

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