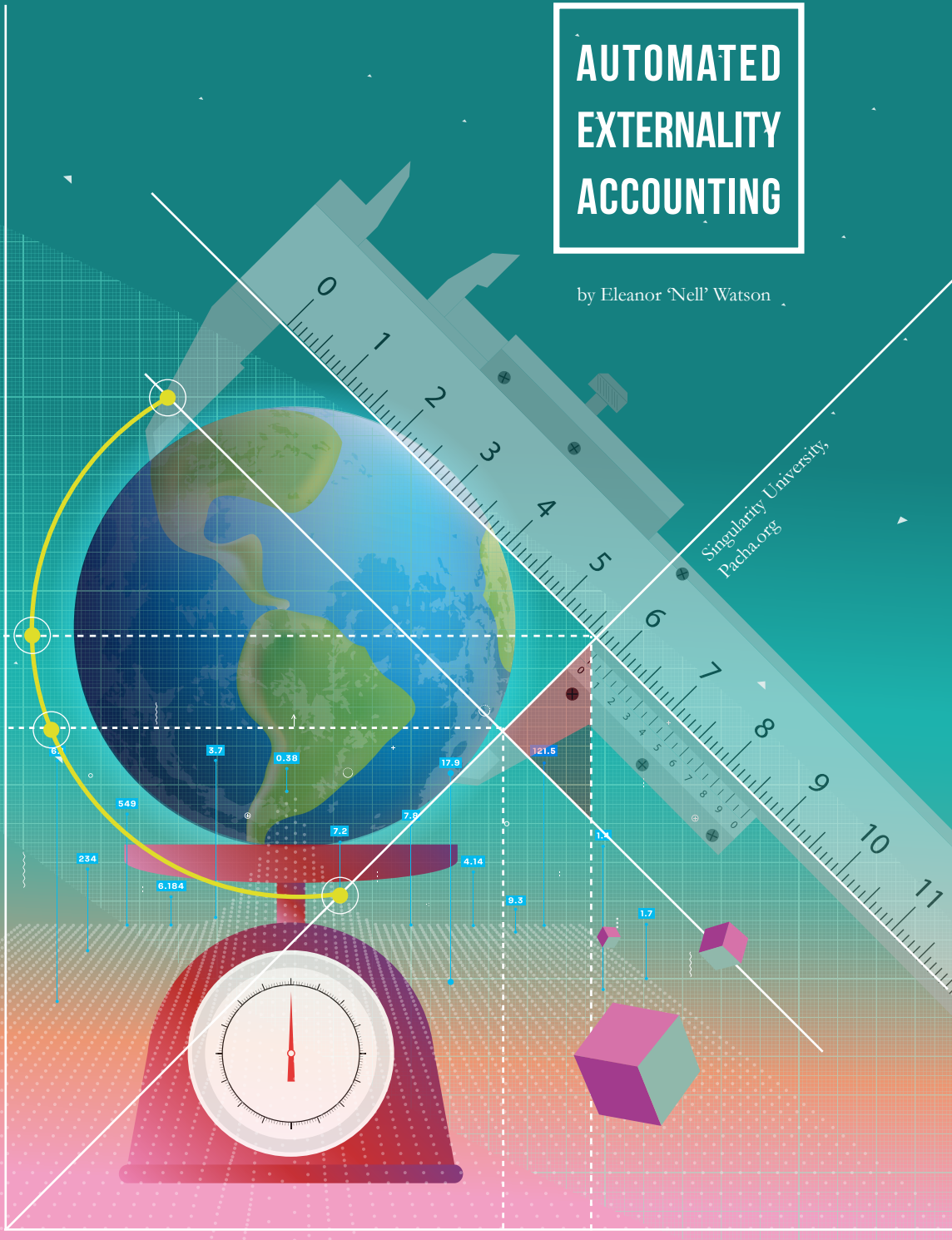


AUTOMATED EXTERNALITY ACCOUNTING

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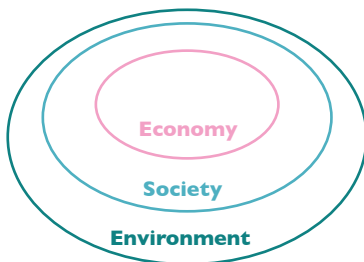
ABSTRACT

The following report discusses the prospect of applying emerging technologies to enable a more sustainable society. Economic transactions often involve the passing of costs such as pollution clean-up and abatement onto unrelated third parties or to the commons; these negative externalities are generally undocumented and unaccounted for.

By the year 2030, we will have an opportunity to leverage machine intelligence to create Automated Externality Accounting networks comprised of automated and networked mechanisms for detection, accountability generation, pricing, and redress of externalities.

These elements will enable us to enjoy the fruits of advanced civilisation in a sustainable manner.

NATURAL CAPITAL



Traditionally, economists have focused on human elements of the economy, not the nature or ecosystems that underpin them. The costs upon nature caused by pollution or resource extraction are not typically accounted for.

In fact, modern industrial society has grown uncontrollably at the expense of the planet's ecosystems, passing along negative costs to nature while masking the true costs of profit. The effects upon the commons are

generally ignored, and the actual costs on natural and social resources have been significantly underestimated. Profits are privatized, and costs are socialised in a hidden subsidy.

“We use nature because it is valuable - but we lose it because it is free.” – Pavan Sukhdev

EXTERNALITIES

Externality, an economics term, occurs when an exchange between a buyer and a seller has an impact on an uninvolved third party. Sometimes the third party who bears the costs is not an individual, but a group, society at large, or the broader ecosystem – the global commons. These negative effects add up to real costs that someone ends up having to pay for: estimates of global externality costs are greater than \$2 trillion¹.

Identifying which externalities exist is also a significant challenge. Mobile distributed sensors have discovered² that industrial methane emissions from Ammonium Nitrate fertilizer plants are 100 times higher than previously reported, for example, illustrating that we have a poor understanding of what externalities are actually occurring, and of who is doing the polluting, with what, and to what degree.

AUTOMATED EXTERNALITY ACCOUNTING

Good governance is concerned with the management and accounting of externalities, but it's generally done after the fact. We lack the capability to manage externalities in a manner that is fast, cheap, incorruptible, transparent, decentralised, and equitable, making products appear less expensive than they actually are.

We will, in the 2020s and 2030s, be able instead to include externalities within pricing mechanisms – to make people pay for them at the point of purchase. Products or services that result in fewer externalities will therefore tend to be cheaper.

This opportunity has arisen due to rapid advancements in a cluster of automation technologies:

- **Machine Intelligence**³. Helps us make sense of situations that appear to be too chaotic to control, and enables us to automate the ineffable – that which cannot be adequately expressed in words or mathematics, but which we know when we experience. This is a fantastic resource for making predictions, generating improved solutions to difficult problems, and optimising very complex variables. Recent research developments also hint at new formulae that could be applied to assist externality tracking systems.
- **Machine Economics**. Blockchain, distributed hash tables, and associated cryptographic technologies enable decentralized mechanisms to align incentives, create a permanent public record, and guarantee escrow in an affordable, trustworthy, and (mostly) scalable manner.
- **Machine Ethics**. We can instil prosocial behaviours and values into machine intelligence by collecting examples from multiple cultures, demographics, and geographies, informing the artificial intelligence of our general preferences on an individual and societal level.
- **Internet of Things (IOT)**. Sensors are becoming more affordable and powerful all the time. Soon, they may even be commonly embedded within consumer electronics.

These technologies are rapidly maturing at a time when the United Nations' Sustainable Development Goals call for change. Through Automated Externality Accounting, we can preserve the commons, grow new market opportunities in private industry, and develop new sources of funding to invest in a sustainable future.

1. https://www.youtube.com/watch?v=VZWnMaX_bsY

2. <http://news.cornell.edu/stories/2019/06/industrial-methane-emissions-are-underreported-study-finds>

3. <https://iopscience.iop.org/article/10.1088/1757-899X/537/6/062024/pdf>



DETECTION OF EXTERNALITIES

In order to account for externalities, one must know they exist, along with their location and extent. Initiatives such as Open Air Quality⁴, enable ‘citizen scientists’ with air pollution monitors to aggregate their own data and help triangulate the sources of pollution: consumer sensors can be bought for as little as £30, with prices dropping all the time. Pollution control and compliance may be verified through techniques such as satellite monitoring.

EXTERNALITY PRICING

Pricing externalities is a technically and politically sophisticated challenge.

There is a question of whether externality costs should be accounted for in full immediately, or through some graduated means. There is also a question of whether past externalities should be accounted for, and if so, then how far back should this accountability go.

Generally, a statute of limitations will apply with regards to civil tort liabilities. One could simply write off all prior externality effects altogether and start from a blank slate. This may be the most politically palatable.

Externality accounting mechanisms may allow the trading of pollution permits: a sustainable number of (infinitely divisible) permits could be produced and allocated to every individual and company. Those who are less flexible in their pollution activities could buy extra pollution permits from those who have more flexibility and are willing to trade them. Those who reduce their externalities cheaply could make a profit by auctioning off their permits to others. Externalities in specific locations may result in an extra cost due to their amplified effects there and should be priced appropriately⁵.

Regulators may also imprint a warning on a product label to warn that it produces a large number of (explicitly quantified) externalities to help consumers make more informed purchasing decisions⁶.

EXTERNALITY FUTURES & DERIVATIVES

Futures markets may have an important role to play in pricing the costs of externalities. Derivatives are a massive component of the modern economy, and those based on externalities may lead to substantial new markets. Such derivatives could be based on the future costs of externalities or long bets on the eventual remediation of their negative effects upon the commons.

Predictive processes could be used as part of a pricing mechanism, by asking people to make a prediction on the price at a specific date in the future based on the status quo or a given policy. Banked allowances have enabled⁷ speculators to buy permits now under the belief that they will be more expensive/scarcely in the future; if expanded to other forms of externalities, these could become a substantial secondary market.

4. <http://www.openaq.org/>

5. <https://web.archive.org/web/20001210164500/http://www.globalideasbank.org/crespec/CS-109.HTML>

6. <http://mason.gmu.edu/~rhanson/wouldhavebanned.html>

7. <https://www.latimes.com/business/hiltzik/la-fi-hiltzik-captrade-20180111-story.html>

AUTOMATED REDRESS, AUTOMATED CLASS ACTIONS

Identity requires a permanent and discrete separation from peers. The commons possess no identity, and therefore it has no rights and no legal standing. What if we could change that en masse?

Organisations such as What3Words.com enable one to express a 3m² geolocation using just three words, a convention which is now used by the Mongolian postal service⁸. Imagine if we used similar techniques to generate ‘parcel codes’ that delineate individual gullies, tributaries, ponds, oceans, glades, and woods. We could then give each patch of Earth its own unique identity.

Attempts have been made to give some legal status to certain rivers, generally by indigenous groups. So far, such initiatives have not been given much legal credence. By connecting these identity-deriving mechanisms to AEA, one could automatically register ‘environmental persons’ en masse – formalised legal personalities that help illustrate legal standing for natural capital. An associated trust could represent the wellbeing of that legal entity, receiving its funds as redress for being polluted or unsustainably depleted of its natural resources.

This concept would also be suitable for patches of Earth outside of national sovereignty – oceans and seabeds, the upper atmosphere and outer space, the polar regions. A stateless legal person can still seek redress in court. Land in foreign jurisdictions might still be addressable using such a mechanism, just like a natural person may be granted citizenship of a country other than the one in which they reside. There is already an established legal principle whereby a third party may volunteer to step in as a legal guardian for a child who has none, such as a foster child.

Such principles may enable third parties to act as the guardian of a parcel of nature that has had its interest infringed upon. The detection and collection of necessary evidence could be automated, as could the accounting and submission of the proper legal forms for a class-action lawsuit. Successful automated legal processes have been used to great effect already. DoNotPay⁹, for example, has overturned thousands of motor vehicle tickets and citations.

Part of the income derived from levied fines should subsidise the identification of new externalities; payment from externality costs should be reinvested to help to correct violations. Part of the redress cost from externality violations may also be held as a bounty for their remediation.

Positive externalities from genetic or cultural resources, for example, could also be rerouted into the communities and zones from which they came. A monkey selfie¹⁰ type of situation, whereby intellectual property is created or discovered within part of the natural ecosystem, could be held in trust to help protect the habitat it came from.

DRIVING ADOPTION

Certain blockchain-based initiatives (e.g. SolarCoin) have a model whereby they give away tokens in exchange for a demonstrable positive externality, such as generating electricity. Whilst the initial value of the tokens may be very low, as the value rises people may become more motivated.

People have invested¹¹ vast sums of money in computer graphics cards and energy usage simply to redeem a single bitcoin – if one gave away tokens for planting trees or cleaning up litter, one could incentivize productive behaviour. Verification may be challenging, though AI and cryptographic techniques linked to real-world matter may assist.

8. <https://www.bbc.com/news/uk-england-49319760>

9. <https://www.theguardian.com/technology/2016/jun/28/chatbot-ai-lawyer-donotpay-parking-tickets-london-new-york>

10. https://www.wikiwand.com/en/Monkey_selfie_copyright_dispute

11. <https://www.theverge.com/2019/7/4/20682109/bitcoin-energy-consumption-annual-calculation-cambridge-index-cbeci-country-comparison>

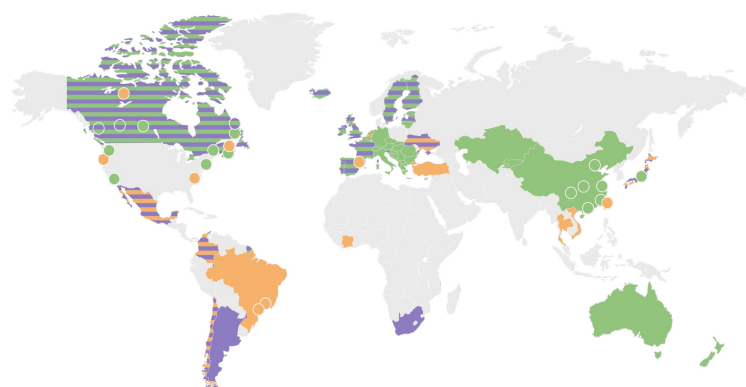


POLITICAL PRACTICALITIES

Carbon Credits/Cap & Trade initiatives have experienced many challenges, sometimes met with scorn from those who view them as a 'stealth tax and a bureaucratic nuisance', or for being 'morally bankrupt and a license to kill'.

Implementers of AEA must learn from the various successes and failures of prior initiatives, not thinking of it as merely a more sophisticated Pigouvian tax¹³ or opportunity¹⁴ for rent-seeking by authorities. On the contrary, it must be seen as proper, scrupulously honest accounting and the reason why some externalities are costed.

Ideally the main focus should not be on politically contentious carbon, instead illustrating opportunities to better manage pollutants that are directly and immediately detrimental to the health of life on Earth – particulates, lead, and endocrine disruptors.



Source: [World Bank](#)

SINAI

GEOPOLITICS & ECOLOGICAL DEBT

AEA may have major geopolitical ramifications with regards to international sanctions or foreign aid, whereby payments and tariffs may be linked to steps taken to reduce externalities.

Geopolitical trade in externality costs or permits may also lead to a trade deficit in that some nations may find themselves trading externalities at a net loss. Operating in this fashion may alter the balance of economic power between nations, and in particular, change the status quo between the global north and the global south.

12. <https://www.smithsonianmag.com/science-nature/the-political-history-of-cap-and-trade-34711212/>

13. https://www.wikiwand.com/en/Pigouvian_tax

14. <https://pdfs.semanticscholar.org/71b1/4a570df5d00515717f2625d712e7a966a92e.pdf>

SOCIAL EXTERNALITIES

Externalities are not only environmental; they're social, too. One could create a lottery that randomly rewarded¹⁵ people with a modest bonus for prosocial action by earning free tickets towards a potential reward.

Social externality tracking could also be used to negotiate a higher place in a particular queue if one happened to be in a hurry, exchanging a credit for someone else's voluntary sacrifice.

CONCLUSION

It is necessary to bring forth an Industrial Reformation that can successfully manage the worst excesses and social costs that previous phase shifts have brought forth. This process must be gentle and non-coercive, but at the same time unyielding. Automated Externality Accounting offers radically improved forms of governance within the next five to 10 years and beyond.

The financial reforms of the 1980s positioned London as a prime securities trading centre. Today, the UK has a similar golden opportunity to drive global leadership in AEA and externality trading markets. Such endeavours will be built through an alliance of interoperable solutions for externality detection, accounting, trade, and arbitration.

Let's restore hope in the future by illuminating a path to a more sustainable, cleaner, and equitably prosperous world. Information and links that relate to this report will be posted at www.pacha.org.

AUTOMATED EXTERNALITY ACCOUNTING CAN ENABLE

ECONOMIC PILLAR		ENVIRONMENTAL PILLAR		SOCIAL PILLAR	
1 NO POVERTY	2 ZERO HUNGER	6 CLEAN WATER AND SANITATION	7 AFFORDABLE AND CLEAN ENERGY	4 QUALITY EDUCATION	5 GENDER EQUALITY
3 GOOD HEALTH AND WELL-BEING	8 DECENT WORK AND ECONOMIC GROWTH	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	13 CLIMATE ACTION	10 REDUCED INEQUALITIES	11 SUSTAINABLE CITIES AND COMMUNITIES
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE		14 LIFE BELOW WATER	15 LIFE ON LAND	16 PEACE, JUSTICE AND STRONG INSTITUTIONS	17 PARTNERSHIPS FOR THE GOALS

SUSTAINABLE DEVELOPMENT GOALS

ACKNOWLEDGEMENTS AND THANKS

Special thanks to Michael Michalchik, Robin Hanson, Tom Symons, Vector Newman, Nicholas Gogerty, Alfie Rustom, William Cooke, Anand Murthy, Kunal Sood, Steven Stutts, and Skinner Layne for sharing various insights, influences, and opportunities which have shaped this report.

15. <http://mason.gmu.edu/~rhanson/charityangel.html>