Social tipping dynamics for stabilizing Earth’s climate by 2050

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PNAS February 4, 2020 117 (5) 2354-2366; first published January 21, 2020 https://doi.org/10.1073/pnas.1900577117

Contributed by Hans Joachim Schellnhuber, November 15, 2019 (sent for review January 22, 2019; reviewed by J. David Taber and Jessika E. Trancik)

Significance

Achieving a rapid global decarbonization to stabilize the climate critically depends on activating contagious and fast-spreading processes of social and technological change within the next few years. Drawing on expert elicitation, an expert workshop, and a review of literature, which provides a comprehensive analysis on this topic, we propose concrete interventions to induce positive social tipping dynamics and a rapid global transformation to carbon-neutral societies. These social tipping interventions comprise removing fossil-fuel subsidies and incentivizing decentralized energy generation, building carbon-neutral cities, divesting from assets linked to fossil fuels, revealing the moral implications of fossil fuels, strengthening climate education and engagement, and disclosing greenhouse gas emissions information.
The rate of emissions reduction that is needed to reach the Paris climate targets
How to tip the world to a decarbonized state?

- Incremental / gradual change and rapid change

- Social tipping has deep roots, going back to Schelling, Granovetter et al., recent literature review: Milkoreit et al., Environmental Research Letters (2018)

- Evidence for social tipping effects in data and models of public opinion, social norms, investment choices on financial markets etc. (e.g. Nyborg et al., Science, 2016)

- Recent experimental evidence for Pareto principle in social tipping: ~25 % minority of actors can change the majority’s attitudes etc. (Centola et al., Science, 2018)
Social tipping dynamics

- Small interventions with big system effects
- Compatible with SDGs

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# Expert elicitation results

| Social tipping element | Tipping intervention | Control parameter | Potential to reduce GHG emissions | Dominant social structure level | Estimated time need to trigger tipping |
|------------------------|----------------------|-------------------|-----------------------------------|--------------------------------|----------------------------------------|
| STE1: Energy production and storage | TI1.1: Subsidy programs | | Up to 21% globally in one year (Coady et al. 2015) | National policy (Coady et al. 2015) | 10-30 years (Williamson 2000) |
| | TI1.2: Decentralized energy generation | The price of fossil-fuel-free energy | Up to 100% in power supply (Dalton, Lockington, and Baldock 2009) | Community / town governance (Yadoo and Cruickshank 2012) | Less than 10 years (Aylett 2013) |
| STE2: Human settlements | TI2.2: Carbon neutral cities | The demand for fossil-fuel free technology | Reduction by 32% in 14 years (Energy Cities 2010) | Urban governance (Energy Cities 2010). | Approx. 10 years (Energy Cities 2010). |
| STE3: Financial market | TI3.1: Divestment movement | Profitability of fossil fuel exploitation | 26% emissions tied to investments of a Canadian large university (Ritchie and Dowlatabadi 2013) | Market exchange, enterprise (Carrington 2016) | Very rapid, could occur within hours (Kotz 2009) |
| STE4: Norms and values system | TI4.1: Recognizing the immoral character of fossil-fuels | The perception of fossil-fuels as immoral | Unprecedented | Informal institutions, enforcement through peer-groups (Padilla and Perez 2003) | 30-40 years (Nadelmann 1990) |
| STE5: Education system | TI5.1: Climate education | Climate change and impacts awareness | Up to 30% reduction in two years in the emissions of the included in the study Italian households (RACES 2011) | National policy (Story, Nanney, and Schwartz 2009) | 10-20 years (Story, Nanney, and Schwartz 2009) |
| STE6: Information feedback | TI6.1: Emission information disclosure | The number of products and services disclosing their carbon emissions | Up to 10% reduction of emissions in UK households grocery consumption in a year (Upham, Dendler, and Bleda 2011) | Market, exchange (Fraser 2017); enterprise (Banerjee and Solomon 2003) | A few years (Siró et al. 2008) |

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Inducing a global social tipping

World system of human societies
Social structure layers

Customs, norms, religion

Policies and regulations
Infrastructure

Technology
Governance

Resource allocation, market exchange

Earth’s climate system
Climate tipping elements

GHG emissions and land use

Climate impacts, windows of opportunity

Positive feedbacks between the STEs

Direct
Indirect
World-Earth system feedbacks

STE4: Norms and values system
STI4.1: Recognition of the moral implications of fossil fuels

STE5: Education system
STI 5.1: Climate education

STE1: Energy production and storage system
STI1.1: Removal of fossil fuel subsidies
STI1.2: Decentralized energy generation

STE2: Human settlements
STI2.1: Carbon neutral cities

STE3: Financial market
STI3.1: Fossil fuel divestment

STE6: Information feedbacks
STI6.1: GHG information disclosure

Estimated time needed to trigger social tipping

Very slow (>30 years)

Slow (~10-30 years)

Rapid (~5-10 years)

Very Rapid (<1 year)

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1. No silver bullet for rapid decarbonization; a silver buckshot is needed

2. Technology alone will not lead to deep transformation;

3. Values and norms are important for stabilizing the new emerging system;

4. About 10-25% committed minority can tip the majority.

5. Who is in the critical minority?
   - Energy producers, energy ministers, teachers, educators, local governments, citizen groups, financial investors, producers, peer groups → human agency
Human agency dimensions

Otto et al. (2020) Ecological Economics
# Global carbon inequalities

| Socio-metabolic Class                  | Percent of global population | Percent of life-style CO2 emissions | The level of human agency                      |
|----------------------------------------|------------------------------|------------------------------------|-----------------------------------------------|
| Socio-metabolic underclass             | 20%                          | 2.5%                               | Extremely low                                 |
| Socio-metabolic energy poor class      | 30%                          | 7.5%                               | Low                                           |
| Socio-metabolic lower class            | 30%                          | 22%                                | Low individual and moderate level of collective agency |
| Socio-metabolic middle class           | 10%                          | 19%                                | Moderate individual to high level of collective agency |
| Socio-metabolic upper class            | 9.5%                         | 35.4%                              | Very high                                     |
| Super-rich                             | 0.54%                        | 13.6%                              | Extremely high                                |

Otto et al. (2020) Ecological Economics; Data sources: Oxfam 2008; Otto et al. 2019 Nature CC
Thank you