WORKING PAPER

Regional Analysis of Hidden Costs of the Food System Economic Commission Current Trends and Food System Transformation Pathways to 2050: Europe Union Key Figures

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Background Brief for the
Food System Economic Commission

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Key figures

Current hidden costs. Annual European Union (EUR[1]) greenhouse gas (GHG) emissions, nitrogen (N) pollution, and habitat losses and returns from land-use change from food production, poverty, and productivity losses from consumption of unhealthy diets, have current hidden costs of 2.2 trillion USD 2020 PPP (Figure 1S)

What are hidden costs? Food production and food consumption in the current year create costs that will be borne in the near- and long-term future. Indicators such as gross product count the value-add of current activities in purchasing power terms but do not account for the future deficits, this is why the costs are hidden from national accounts and not factored into current markets.

Perspective on economic burden of hidden costs. Roughly, corrected for the purchasing power denied to future economies from hidden costs, EUR GDP would be 11% lower (2.2 trillion USD 2020 PPP is 11% of EUR's 2020 GDP in purchasing power terms). The gross-value add of agriculture in the EUR region was about 1% of GDP in 2020, and a rough estimate of the value-add of the food chain including food manufacturing and processing, and food retail and services, is around 5%[2].

Accumulating deficit. Unlike a shock such as the global financial crises or the COVID-19 global pandemic, the food system produces costs year on year. The hidden deficit accumulates in real terms and poses risk to future growth and prosperity.

Reduction of deficit by transforming food systems. The Food System Economic Commission (FSEC) Food System Transformation (FST) pathway assumes fundamental changes in food production and food consumption between 2020 and 2050. Over this period the FST would reduce accumulated EUR food system hidden costs over 2020 to 2050 by 20% (Figure 1S top panel). The magnitude and composition of the avoided hidden costs changes over the period 2020 to 2050 as the measures in FST are implemented and responded to, but averaged the avoided hidden costs amount to 370 billion USD PPP per year (Figure 2S bottom panel and Figure 3S middle panel). The cost reduction increases over the period (Figure 1S bottom panel Figure 3S right panel). By 2050 the annual hidden costs are reduced by 39% under FST compared to the baseline scenario.

Confidence in benefits increases over the period. The FSEC hidden cost analysis includes large uncertainty in environmental prices for GHG pollution, N pollution, and lost or returning ecosystem services. FST measures for agriculture such as habitat sparing for biodiversity intactness, payment of nitrogen and methane mitigation measures, payment for carbon sequestration, produces uncertainty in the benefits of CO2 sequestration, methane reduction, ammonia, and nitrate pollution, and returning ecosystems services from abandoned cropland. Despite the resulting uncertainty in the avoided hidden costs under FST (Figure 2S), the benefits from change to healthy and sustainable diets increases over the period 2020 to 2050 provides increasing confidence that avoided costs will exceed 400 billion USD PPP per year by 2050 (Figure 1S bottom panel and Figure 2S third from bottom panel). The avoided hidden costs from implementing FST are still increasing in 2050 and likely continue to grow for some decades after 2050.

Composition of avoided costs under food system transformation. Averaged over the period 2020 to 2050, productivity improvements from healthier diets and avoiding obesity provides 78% of the avoided costs (291 billion USD 2020 PPP per year) (Figure 3S middle panel). Avoided costs of climate

[1] FSEC European Union Region EUR features 24 EU member states. Omitted EU member states are Cyprus, Luxembourg, and Malta.
[2] Key figures in the food chain, 2023 edition, Luxembourg: Publications Office of the European Union, 2023.

change, nitrogen pollution, and lost ecosystem services, provide the other 22% (80 billion USD 2020 PPP per year) (Figure 3S middle panel).

Economic costs of degrading blue water resources. Impacts of water scarcity are endogenous to the land-use partial equilibrium model utilised by FSEC, so impacts on agricultural production and undernutrition of water scarcity factor into land-use and body mass index calculations. Lost ecosystem services from loss of environmental flows due to degraded blue water resources are not counted in the hidden cost figures.

Composition of avoided hidden costs from production. Avoided damages from reactive nitrogen surplus (66 billion USD 2020 PPP), GHG emissions (22 billion USD 2020 PPP), make the largest equal contributions to average annual avoided hidden costs from agricultural production (Figure 3S middle panel). Under reactive nitrogen surplus, the main pathways to damages include lost productivity from air pollution due to volatilized ammonia from synthetic fertiliser application and manure and damage to ecosystems from nitrate run-off from cropland and pasture. Avoided ammonia emissions and associated air pollution provides the main benefits from action on nitrogen surplus under FST (35 billion USD 2020 PPP) (Figure 3S middle panel).

Trends of costs over the period 2020 to 2050. Contributions to avoided costs are not constant over the period 2020 to 2050. Avoided cropland expansion under FST occurs in earlier decades, while savings from mitigating nitrogen surplus increase and are the main category of savings as well as the main residual cost on the production side by 2050 (Figure 3S right panel). This is due to diverging input efficiency and agricultural land-use under FST and the baseline scenario. Mitigated CH_4 due to reduced and improved livestock production and CO_2 sequestration from returning forest on abandoned agricultural land makes up most of the avoided GHG damages. On the consumption side, transition to healthy diets is introduced linearly over the period, consequently labour productivity improvements increase over the period from a proportion of 63% of avoided costs in 2030 (142 billion USD 2020 PPP) to 88% in 2050 (372 billion USD 2020 PPP) (Figure 3S right panel). By 2050 there is an uncertain trade-off between land expansion for afforestation and retuning forest habitat from reductions in cropland and pasture.

Trends in economic risk. Economic risk from uncertain costs of GHG emissions, nitrogen surplus and lost ecosystem services decrease under FST. The 95-th percentile of production hidden costs reduces from 270 billion USD PPP in 2050 under the baseline scenario to 137 billion USD 2020 PPP in FST (Figure 6S left and middle panel). The major residual uncertainties in avoided costs from production come from the cost of residual NH_3 emissions and the costs of nitrate run-off weighing up against the benefits of CO_2 sequestration from avoided cropland conversion and returning ecosystem services of recovering forest habitat (Figure 6S right panel).

Comparison with other regions. EUR, USA, India and China reversing current trends of obesity and overconsumption of sugars, salt, and processed foods is one of the main global economic benefits of FST (Figure 5S). Nitrogen surplus mitigation and avoided cropland expansion in EUR, India and China are also major global benefits under FST. The largest global environmental benefits under FST to 2050 come from South and Latin America, and changing agricultural practices and avoiding deforestation in Sub-Saharan Africa as production expands and intensifies.

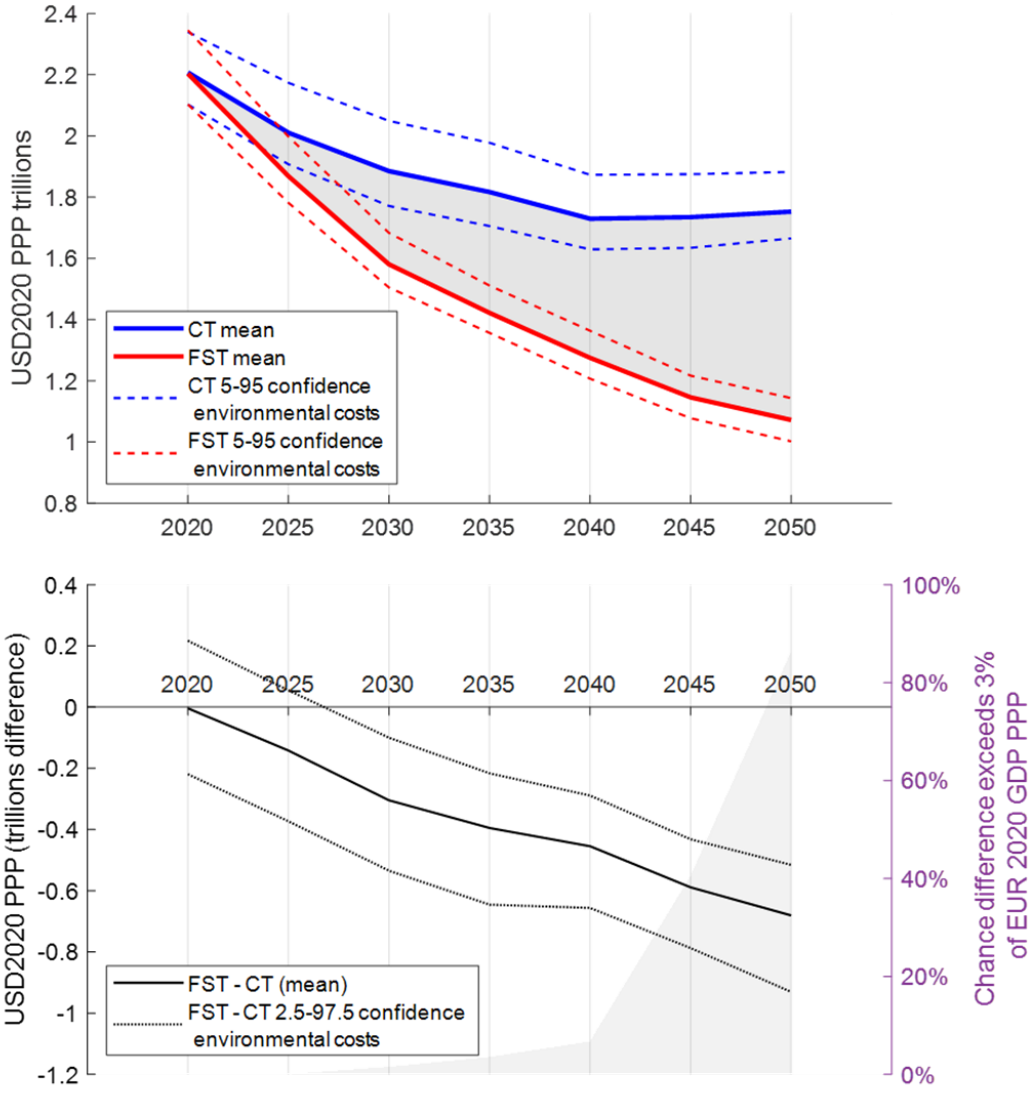

Figure 1S: Trajectory of EURia total annual hidden costs and cost reduction for CT and FST in 2020 USD PPP. Top panel shows the total expected hidden costs under CT (blue) and FST (red). The shaded area between the trajectories indicates the mean value of the total reduction under FST over the period 2020-2050 in 2020 USD PPP. Trajectories of the 5-th and 95-th percentiles of the respective distributions of EUR hidden cost are shown, accounting for uncertainty in the production costs (greenhouse gas (GHG) and reactive nitrogen (N) emissions, lost habitat from land use changes and returned habitat from abandoned agricultural land). Even with high uncertainty in environmental costs the bottom panel shows that hidden cost reduction under FST is very likely (>97.5%) by 2030. By 2050 there is an increasing probability that the reduction exceeds 3% of EUR's 2020 GDP PPP.

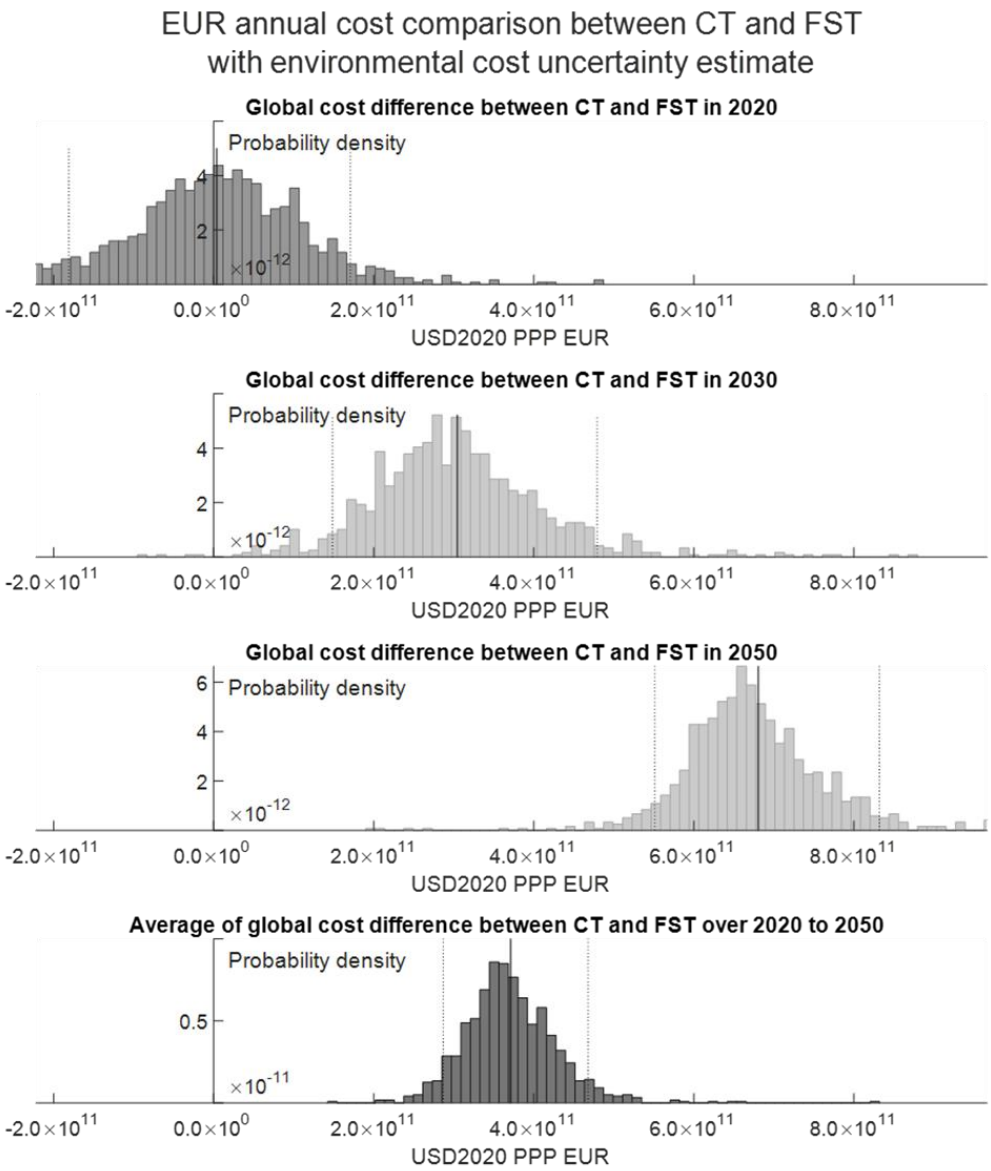

Figure 2S: Distribution of EUR total annual hidden cost reduction under FST in 2020 USD PPP in 2020, 2030 and 2050. Hidden cost reduction can be examined with uncertainty in environment costs in the FSEC study. Figure 1S bottom panel showed the trajectory of the mean and the 5-th and 95-th percentile statistics of the distributions of EUR annual hidden cost reduction under FST. The top, second to top, and second to bottom panels in this Figure show cross-sections of the full distribution of EUR's annual hidden costs reduction in the years 2020, 2030 and 2050. The bottom panel shows the distribution of the total cost reduction divided by the 30 year period (average annual cost reduction). The conclusions that FST reduces hidden costs by 2050, that average annual hidden cost reduction under FST is greater than 200 billion USD 2020 PPP, and that annual hidden cost reduction by 2050 exceeds 400 billion USD 2020 PPP, are robust to the modelled uncertainty in the marginal costs of GHG, N emissions, and ecosystem services.

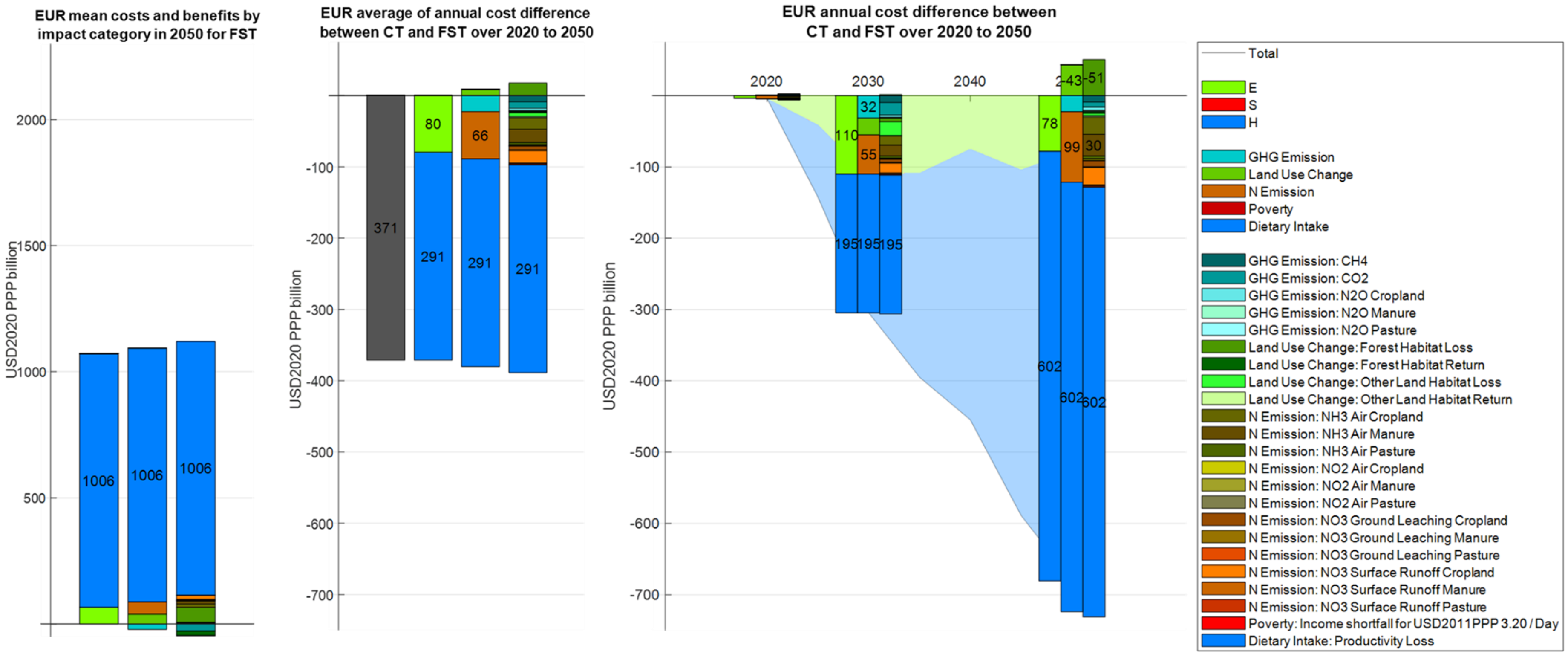

Figure 3S: Breakdown of EUR annual hidden cost reduction under FST in 2020 USD PPP in 2020, 2030 and 2050. Large average hidden cost reductions under FST over 2020-2050 come from burden of disease from food consumption, CH4 emission reductions from livestock and CO2 sequestration from increased forested are, and mitigating NO3-run-off from cropland (middle panel). Up to uncertainty in production costs, reduction in N pollution provides the greatest contribution to production hidden cost reduction over the period 2020-2050 (middle panel). Reduction in N pollution increases later in the period (right panel). Environmental hidden cost reduction and productivity losses from burden of disease from food consumption have an approximately equal contribution to hidden cost reduction over the period 2020-2050 (middle panel). The widespread economic impact of consumption costs due to the structure of the EUR economies (value add of agriculture is 1% of GDP), and existing high efficiency of production and declining agricultural land area in EUR, means that productivity gains from changing diets under FST contributes the most to the benefits of FST (290 billion USD 2020 PPP versus 80 billion USD 2020 PPP on average over the period).

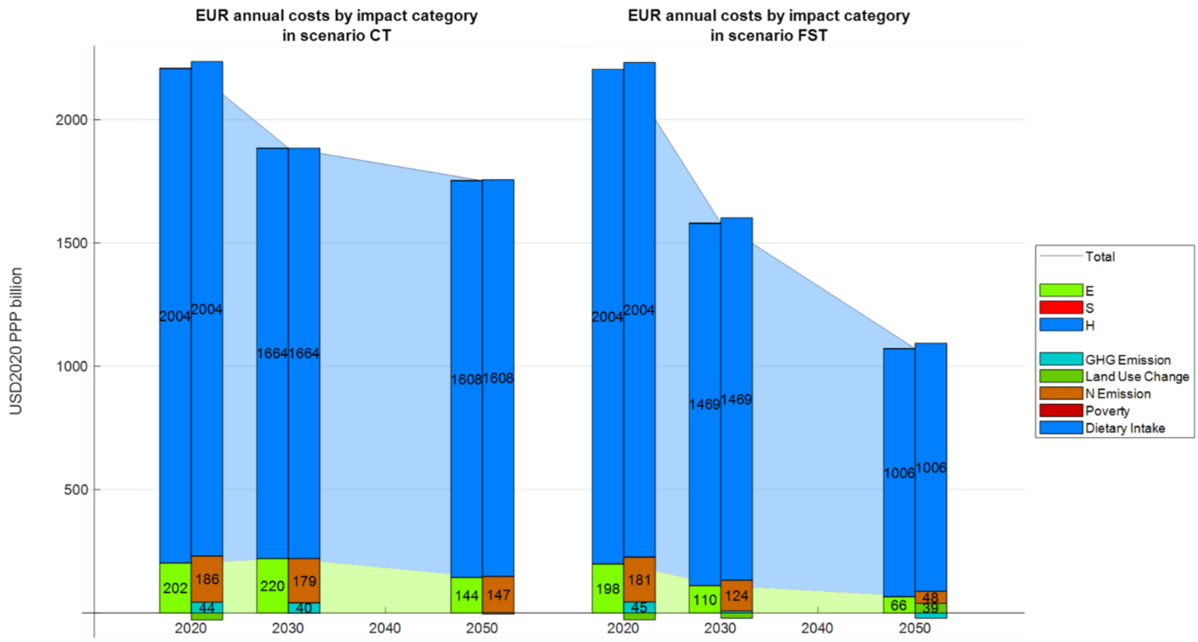

Figure 4S: Transition of consumption way from unhealthy dietary patterns contribute most to annual hidden cost reduction under FST in 2020, 2030 and 2050 for EUR. As a complement to Figure 3S, this Figure shows cost reduction in its context of changes in total hidden costs. Current hidden costs are predominately productivity losses (blue) from consumption and nitrogen pollution (brown). The economic burden from the environmental consequences of agricultural nitrogen pollution under the baseline CT scenario are averted under FST.

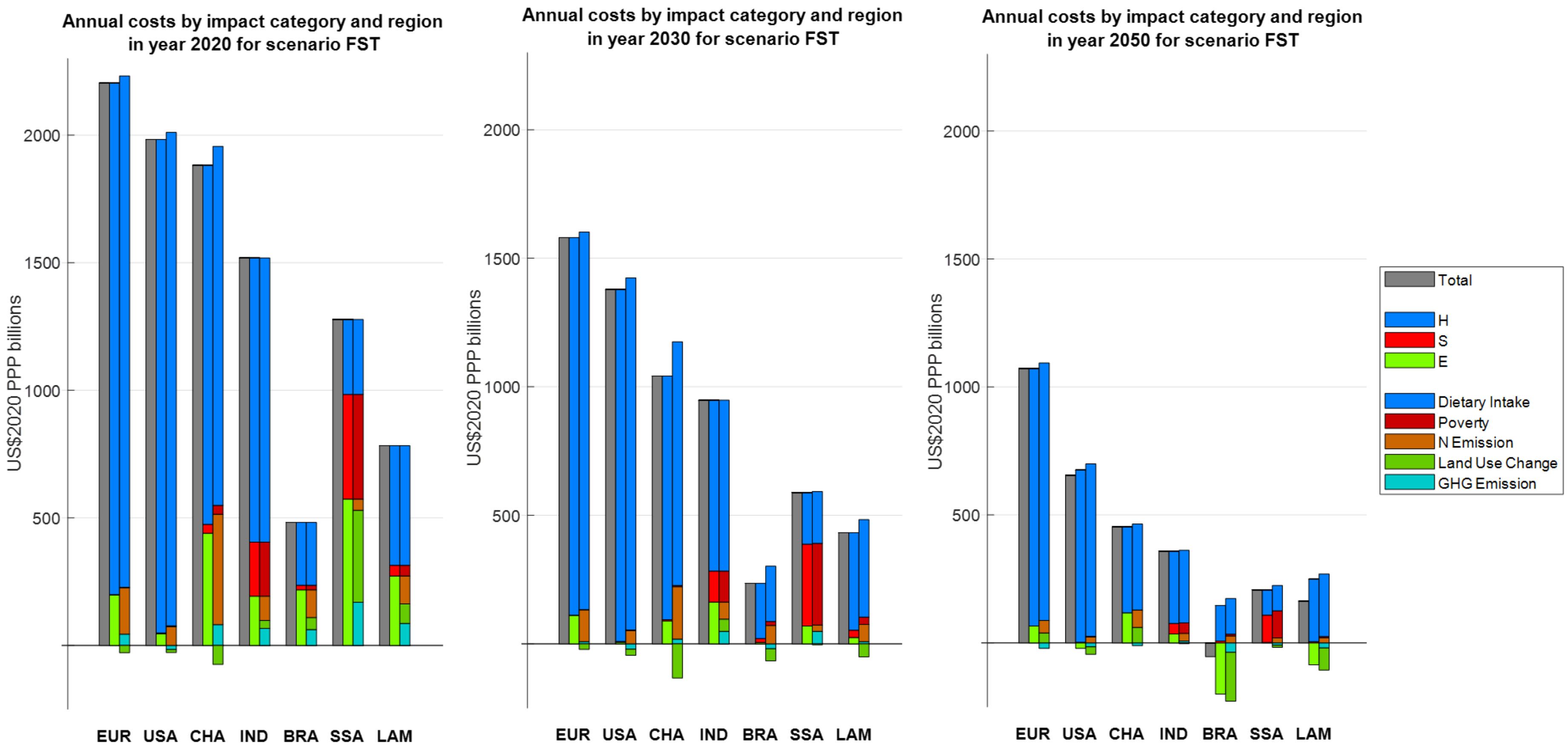

Figure 5S: Comparison of annual hidden costs under FST in 2020 USD PPP in 2020, 2030 and 2050 for 7 FSEC regions. Regional trajectories show transitions in productivity loss from diets and N pollution in China (CHA), India (IND) and EUR (EUR), global GHG cost neutrality from balancing CH4 emissions and CO2 sequestration, land-use change in Brazil (BRA), Latin America (LAM), and Sub Sahara Africa (SSA), and residual poverty in IND and SSA under SSP2.

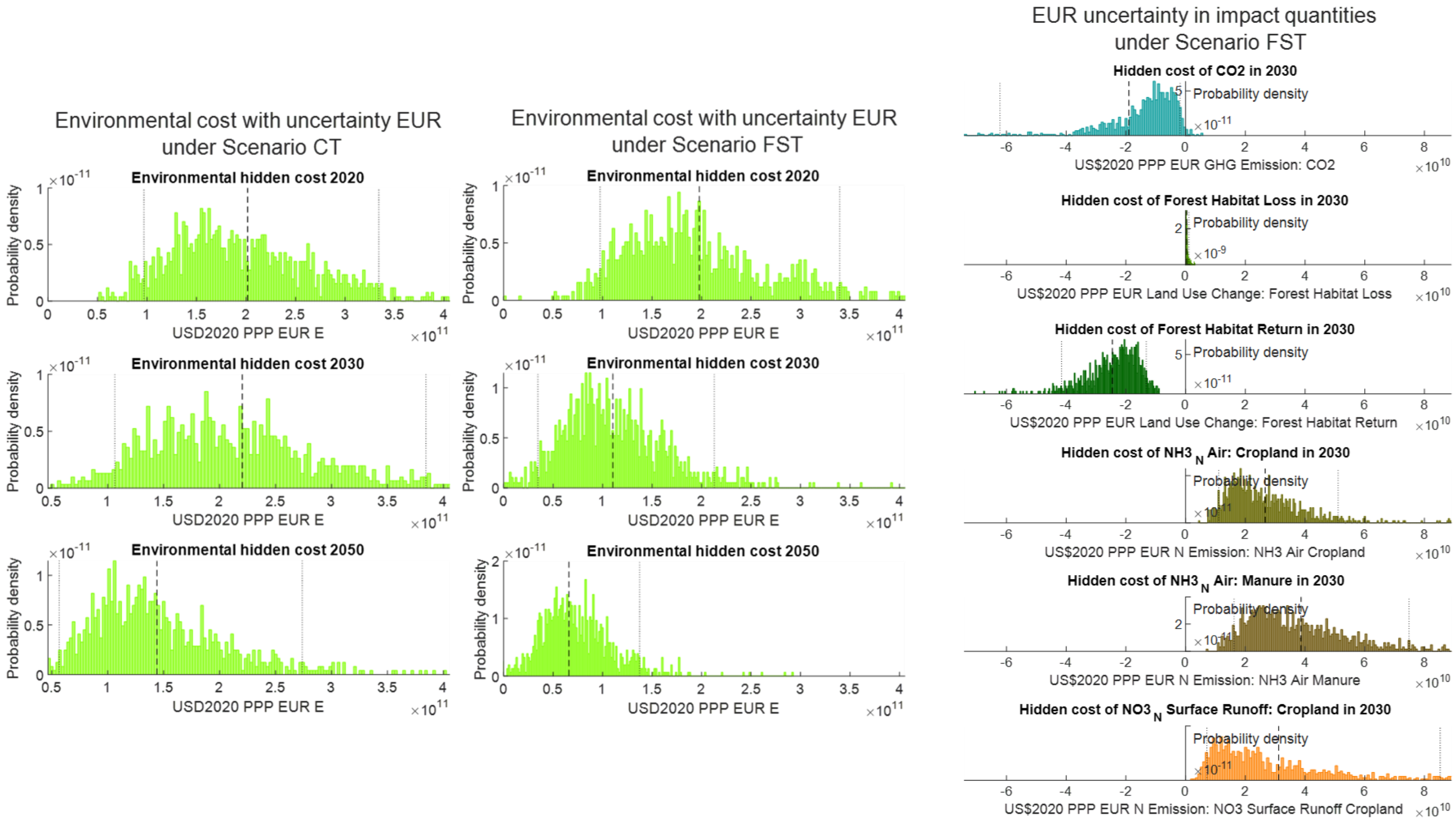

Figure 6S: Distribution of production annual hidden cost reduction under FST in 2020, 2030 and 2050 for EUR. Left panel shows the distribution of environmental hidden cost in 2020, 2030 and 2050 under the baseline scenario CT. Under FST the distribution transitions to higher mass on lower costs by 2050, with a two-fold reduction in the 95-th percentile (middle panel). Uncertainty in the residual hidden costs of production under FST by 2030 resides in benefits items (CO2 sequestration and ecosystem services from return of forest habitat) and cost items (ammonia emissions from cropland and manure and nitrate run-off from croplands), see right panel, with a similar pattern in 2050. By 2050 there is an uncertain trade-off between land expansion for afforestation and retuning forest habitat from reductions in cropland and pasture.