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ZERO WASTE ALLIANCE IRELAND



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Domestic Water Systems
for a sustainable future

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The Urgent Need to Recycle Phosphorus from Human Urine

Presentation by Ollan Herr

The National Sustainability Summit

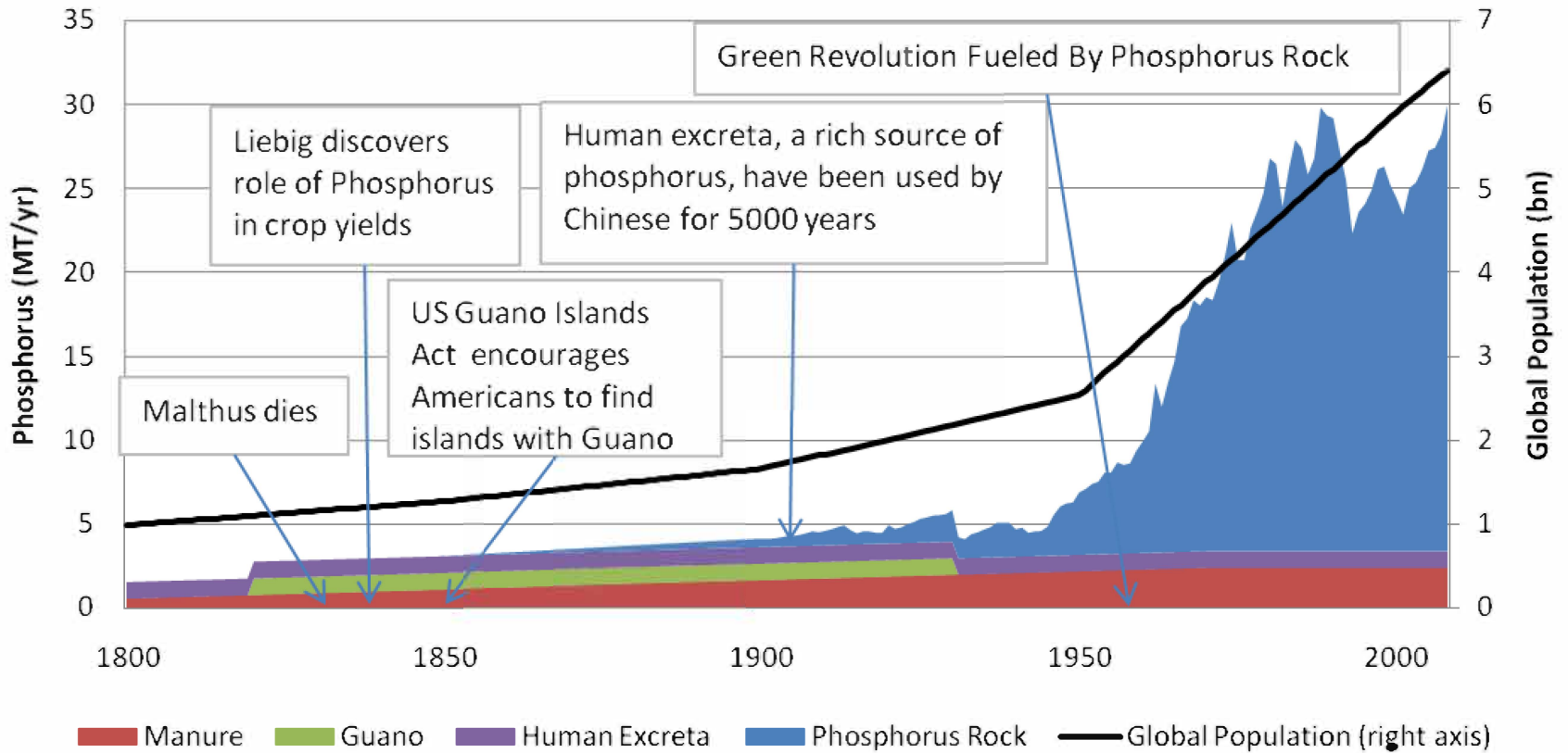
23rd February 2023

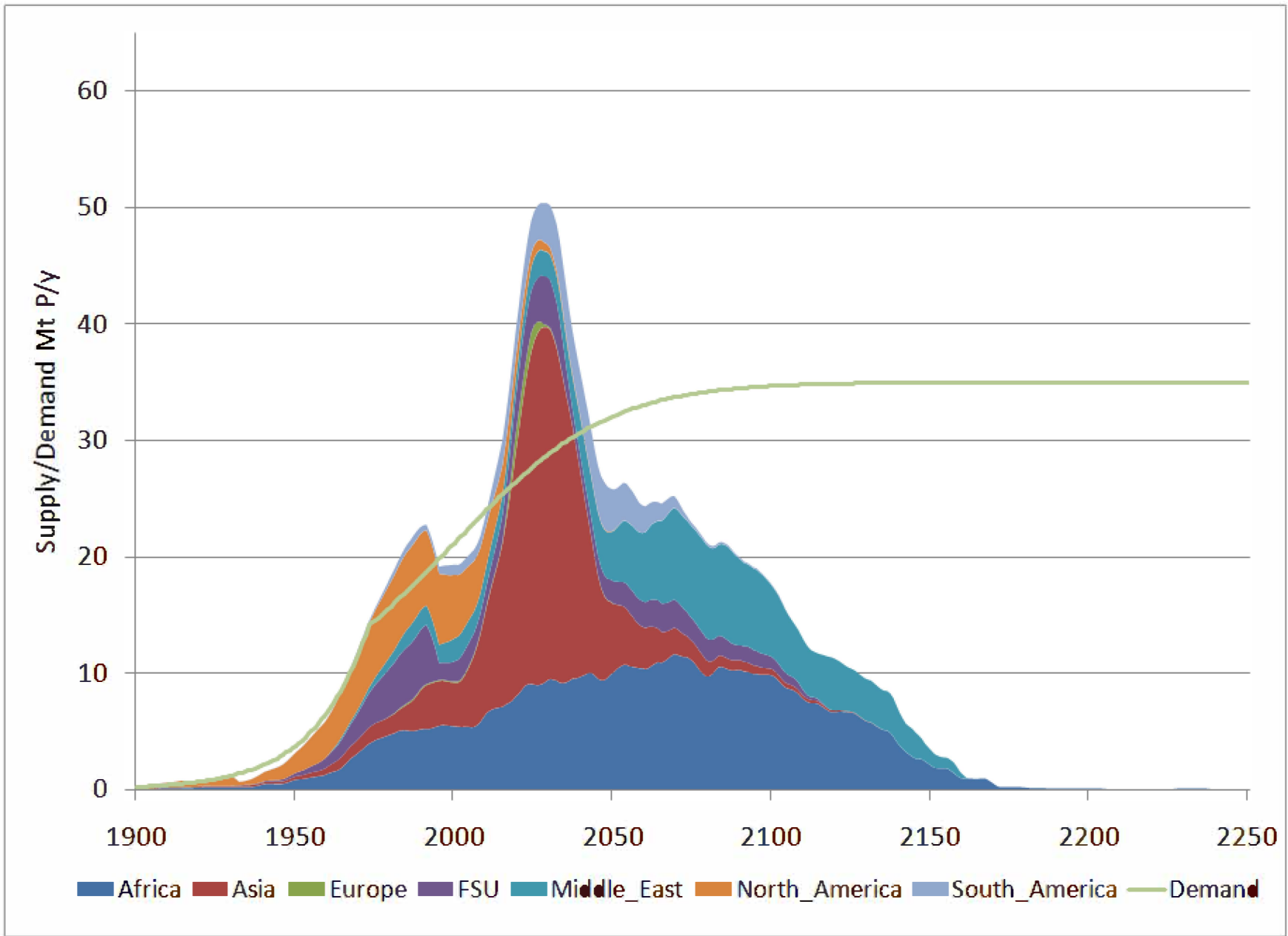
Phosphorus and Nitrogen in Synthetic Fertilizer



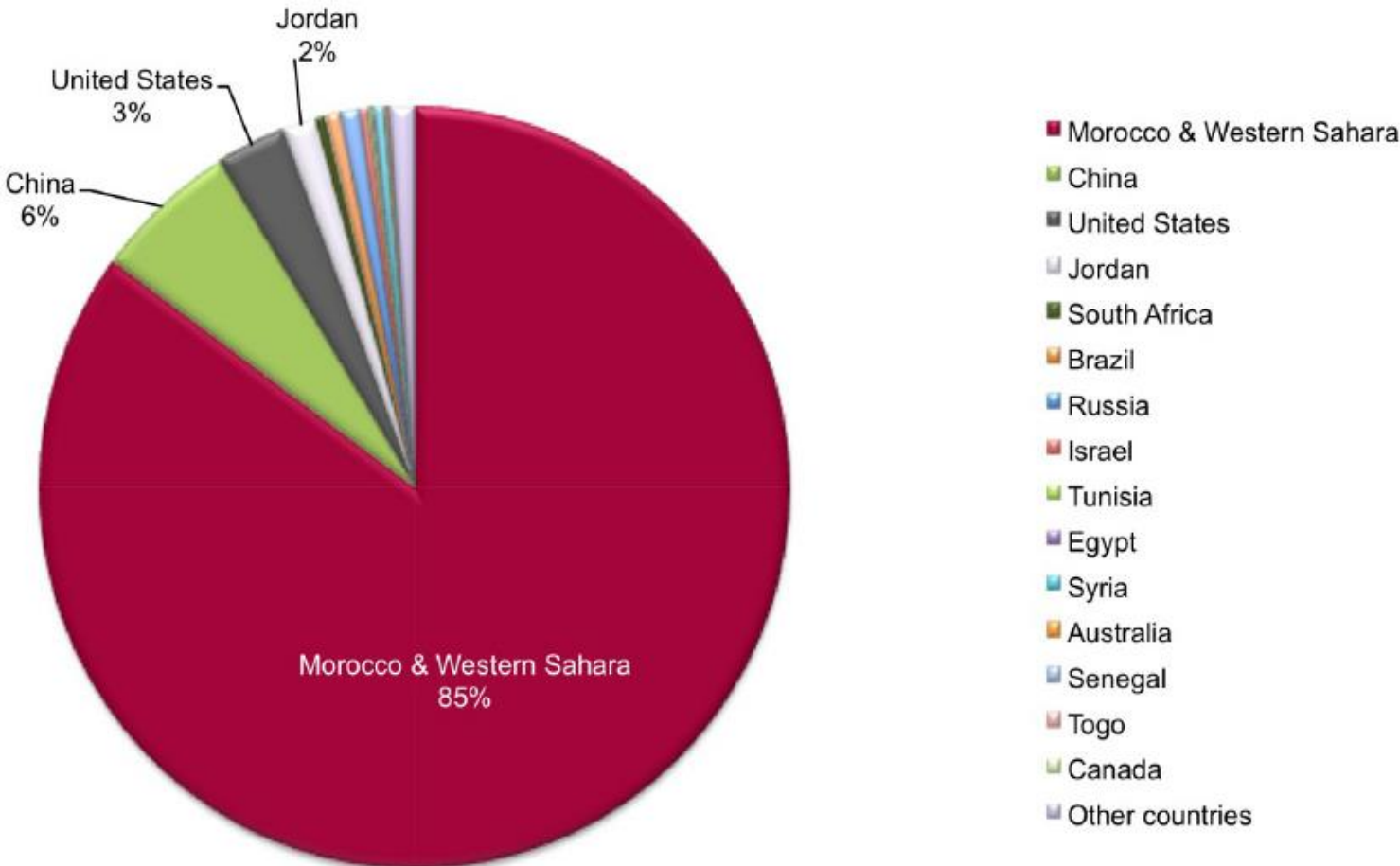


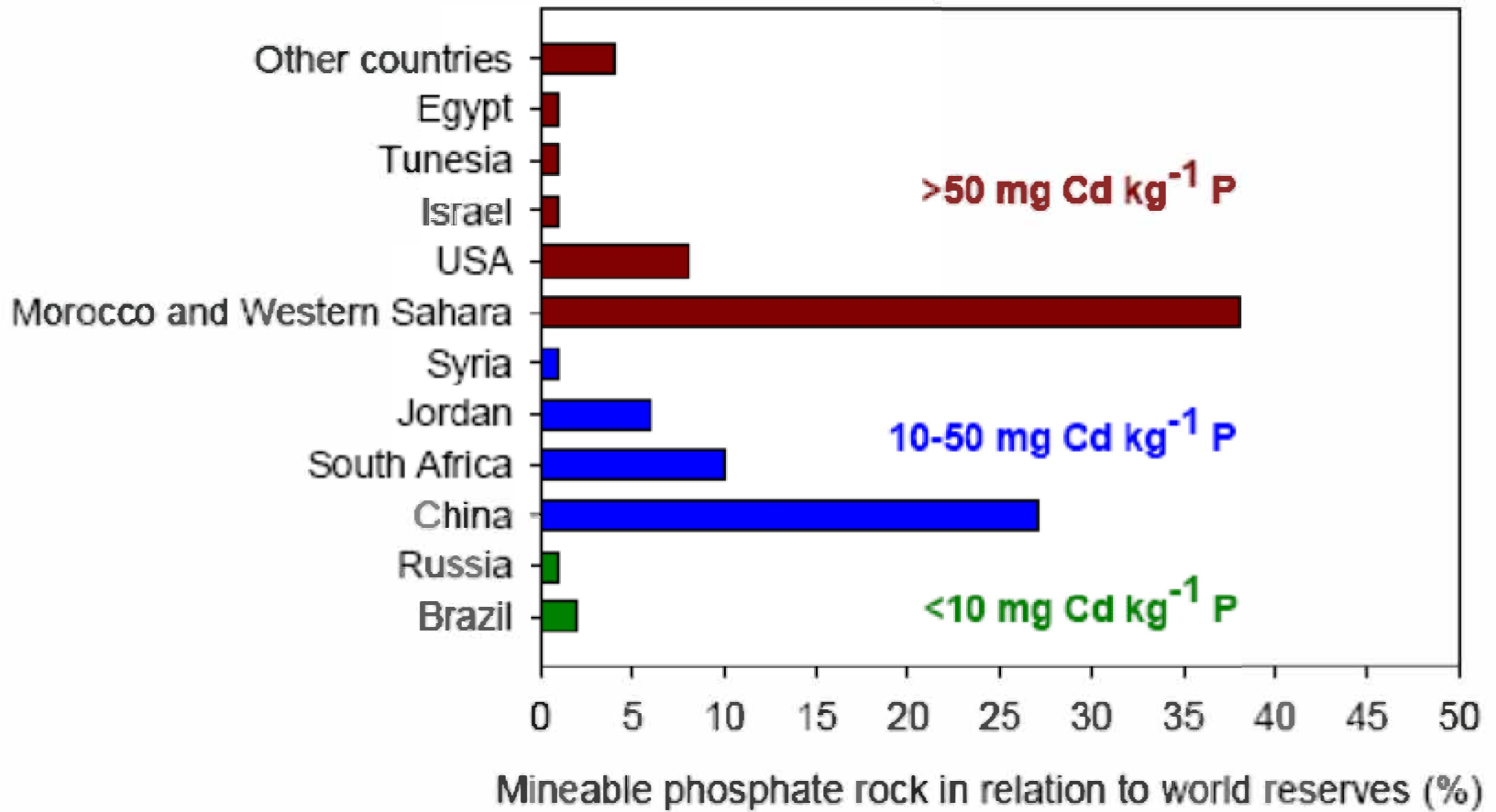
Historical Sources of Phosphorus Fertilizer





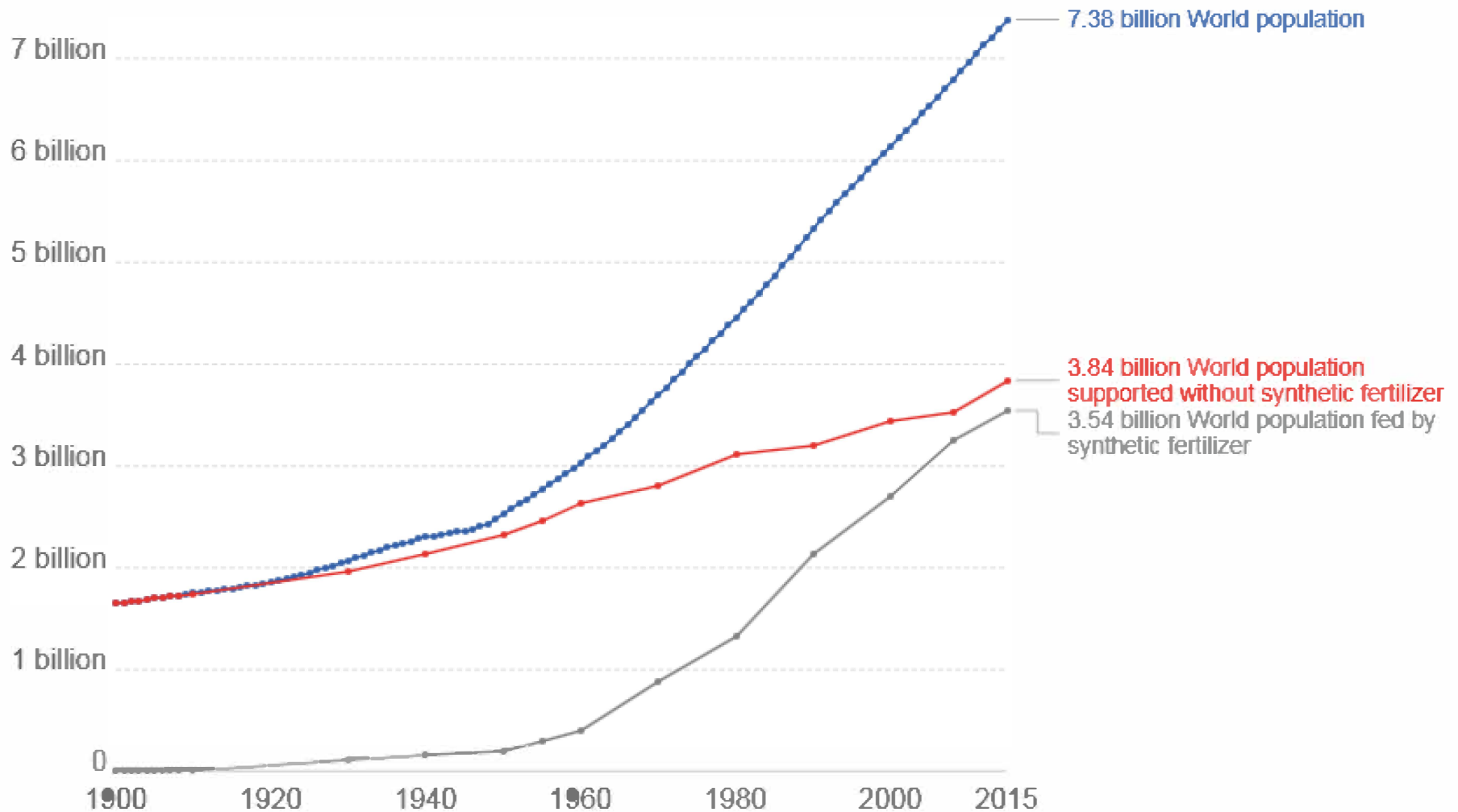
The Remaining Countries with Phosphorus Rock





World population with and without synthetic nitrogen fertilizers

Estimates of the global population reliant on synthetic nitrogenous fertilizers, produced via the Haber-Bosch process for food production. Best estimates project that just over half of the global population could be sustained without reactive nitrogen fertilizer derived from the Haber-Bosch process.

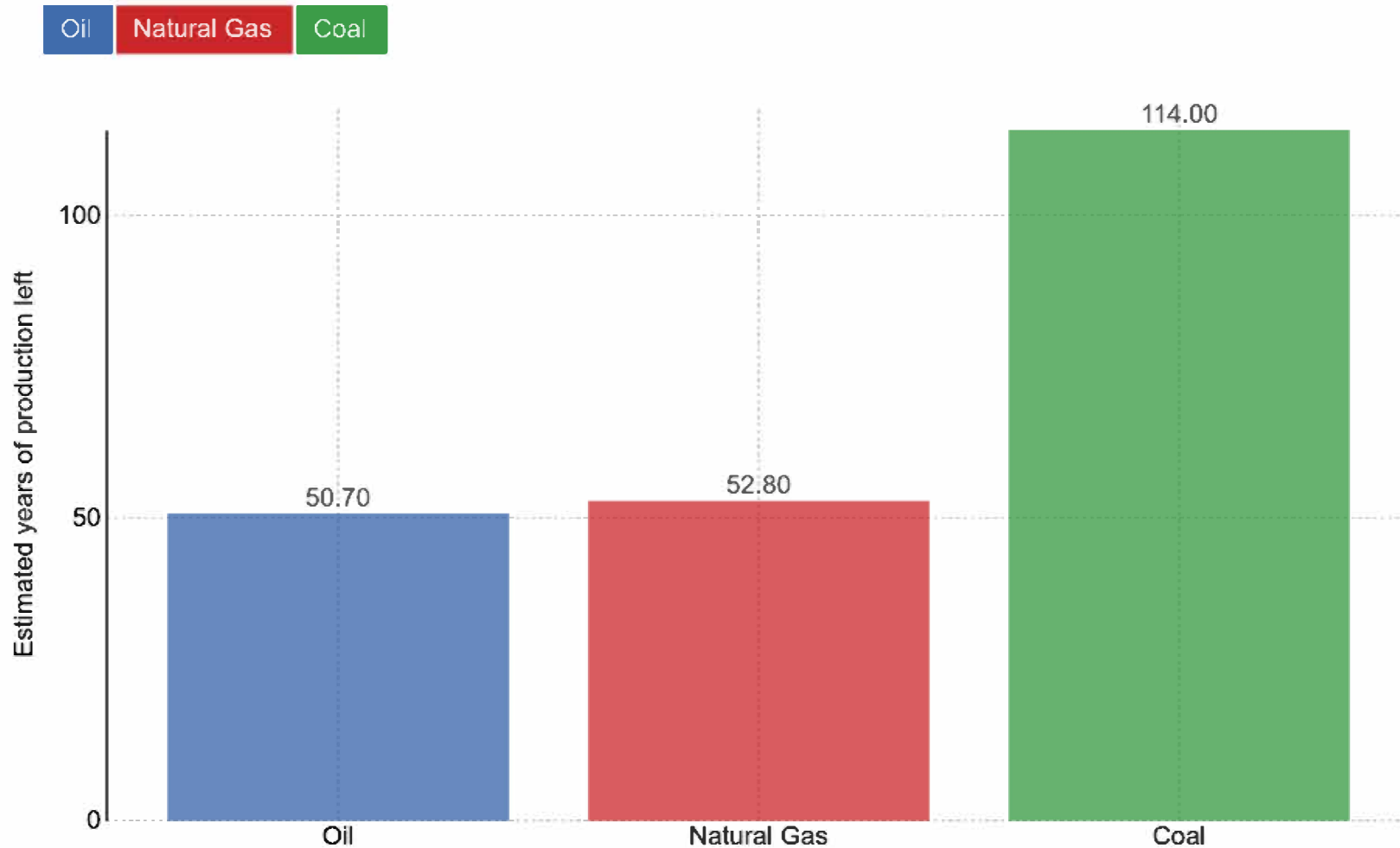


Source: Erisman et al. (2008); Smil (2002); Stewart (2005)

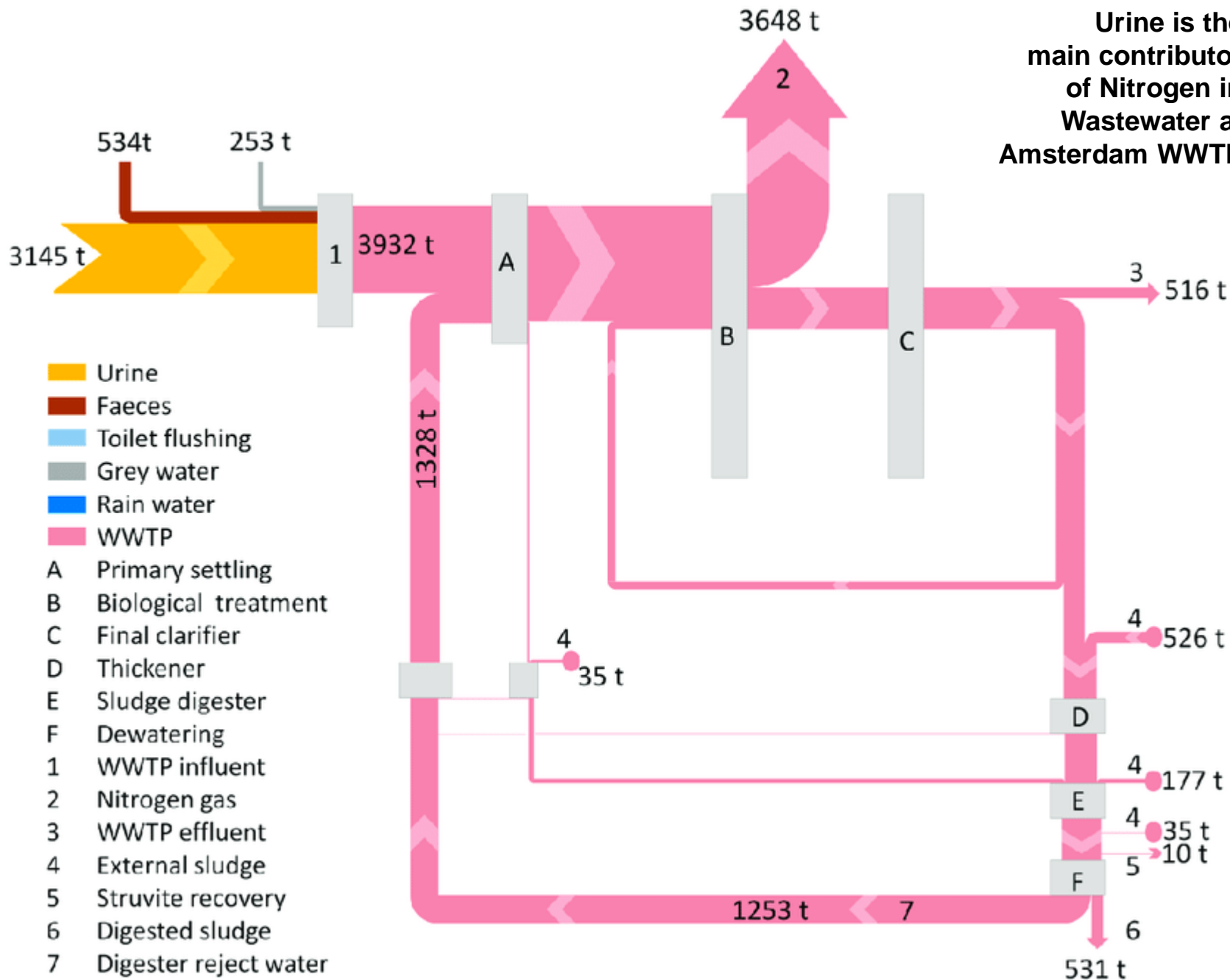
OurWorldInData.org/how-many-people-does-synthetic-fertilizer-feed/ • CC BY

Years of fossil fuel reserves left

Years of global coal, oil and natural gas left, reported as the reserves-to-product (R/P) ratio which measures the number of years of production left based on known reserves and annual production levels in 2015. Note that these values can change with time based on the discovery of new reserves, and changes in annual production



Urine is the main contributor of Nitrogen in Wastewater at Amsterdam WWTP



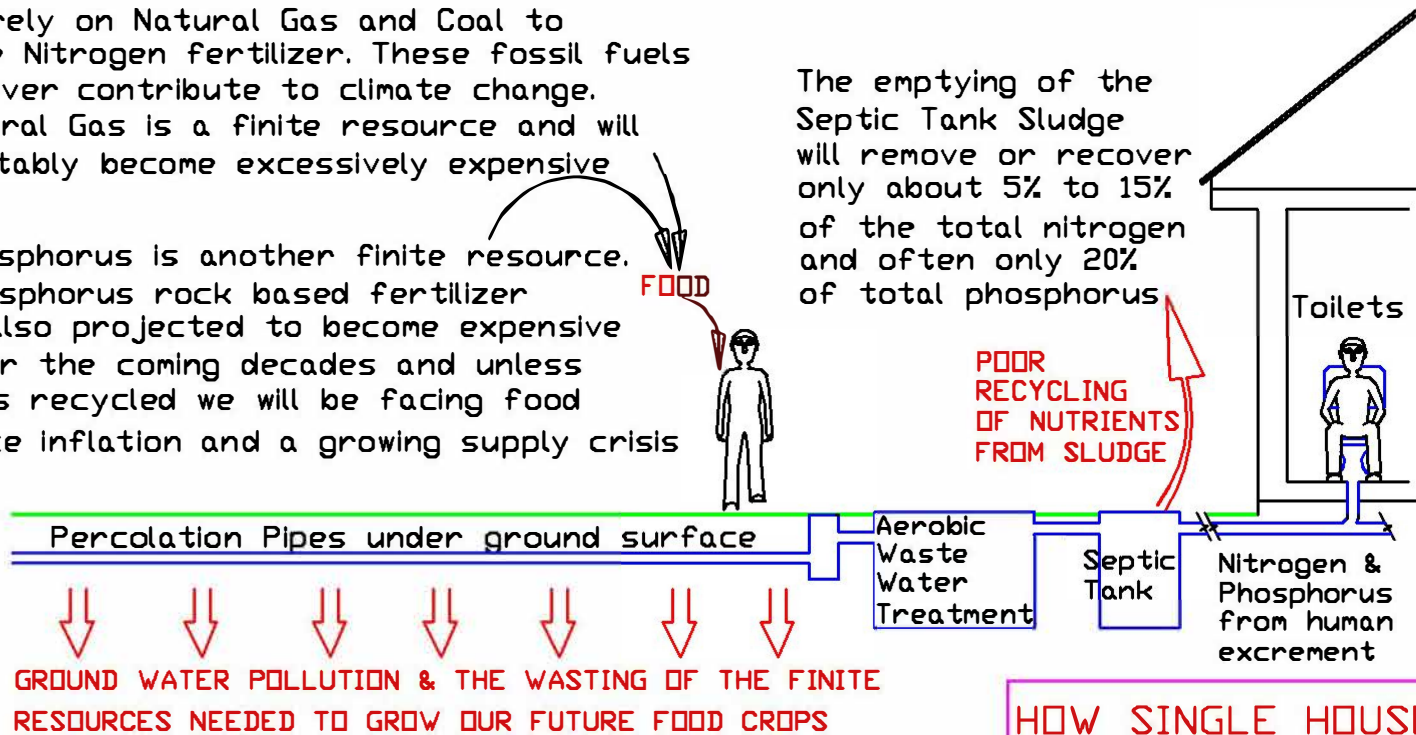
400,000 septic tank systems in Ireland are adding nitrogen into the ground water. The prevention of ground water pollution with nitrates is now a requirement of EU Directive 2006/118/EC. Under this Directive every effort should now be made to protect the ground water pollution from nitrates. We should also be preventing the wasting phosphates

We rely on Natural Gas and Coal to make Nitrogen fertilizer. These fossil fuels however contribute to climate change. Natural Gas is a finite resource and will inevitably become excessively expensive

Phosphorus is another finite resource. Phosphorus rock based fertilizer is also projected to become expensive over the coming decades and unless it is recycled we will be facing food price inflation and a growing supply crisis

The emptying of the Septic Tank Sludge will remove or recover only about 5% to 15% of the total nitrogen and often only 20% of total phosphorus

POOR RECYCLING OF NUTRIENTS FROM SLUDGE

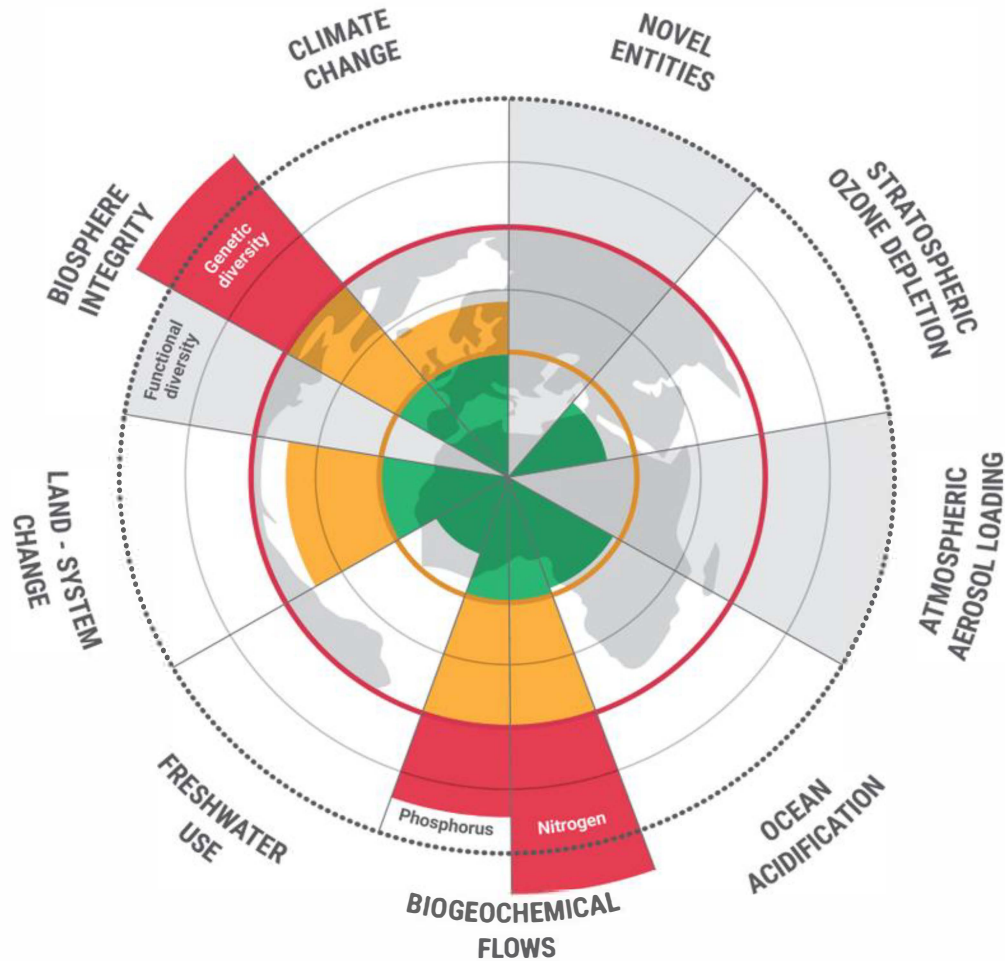


Between 85 % to 95% of remaining nitrogen is lost and wasted in the ground. Unless it is adequately diluted in ground water, it will also become a pollutant.

Between 65 % and 95% of phosphorus is wasted or lost in good percolating soil. It can also become a pollutant in nearby surface waters where there is poor percolating soils

PLANETARY BOUNDARIES

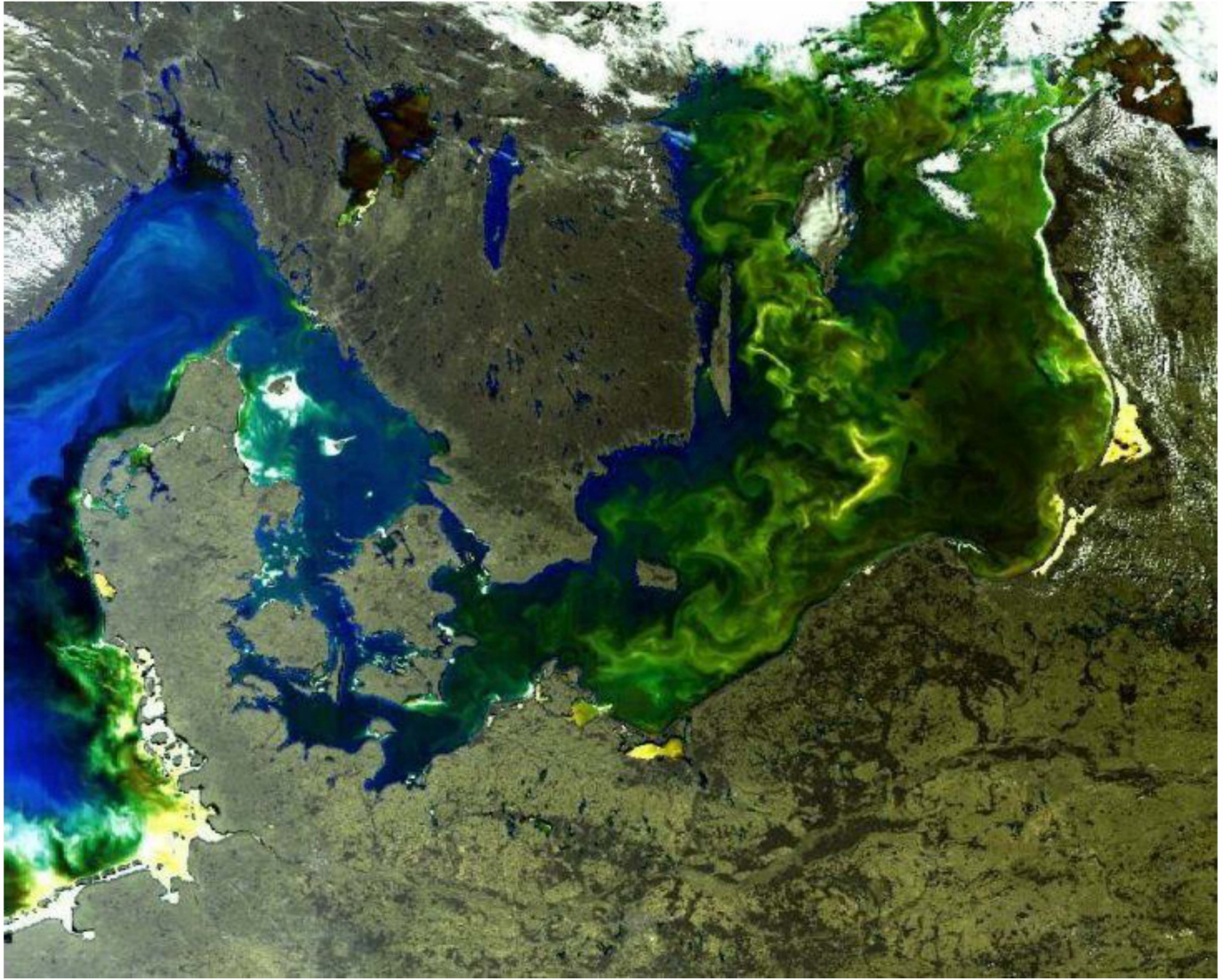
A safe operating space for humanity



- Beyond zone of uncertainty (high risk)
- In zone of uncertainty (increasing risk)
- Below boundary (safe)
- Boundary not yet quantified

Source: Steffen et al. Planetary Boundaries: Guiding human development on a changing planet, Science, 16 January 2015.
Design: Globaia









Comhairle Contae An Chláir
Clare County Council

NOTICE

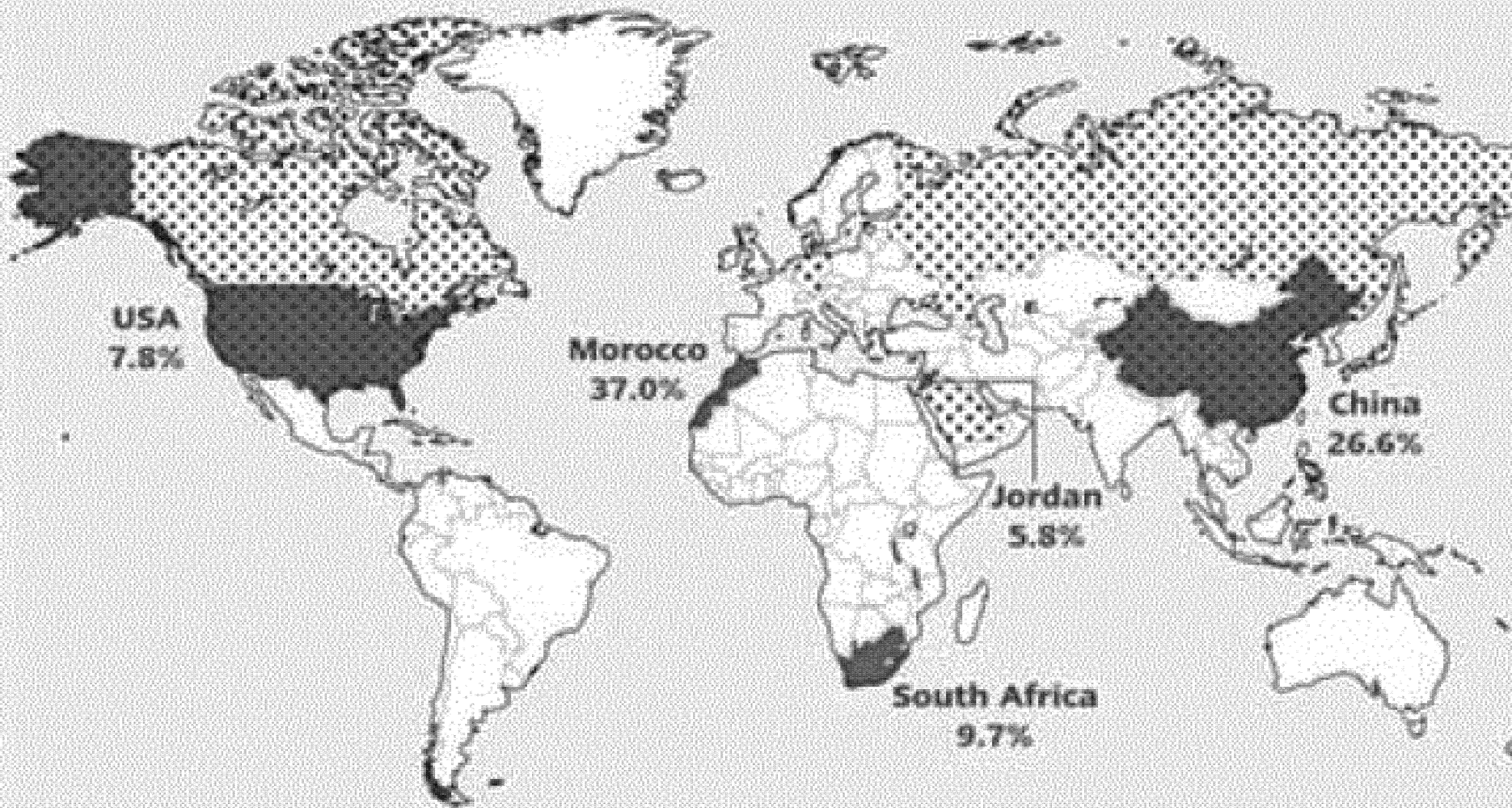
LOUGH DERG WATERS

DURING THIS PERIOD MAY TO SEPTEMBER
AN ALGAL BLOOM OR DARKISH SCUM MAY
APPEAR ON OR CLOSE TO THE SHORELINE

PLEASE EXERCISE CAUTION

YOU ARE ADVISED TO AVOID CONTACT WITH
THIS BLOOM / SCUM AS IT MAY CAUSE SKIN IRRITATION
KEEP CHILDREN AWAY FROM THE SHORELINE
KEEP ALL DOGS AWAY FROM THE WATER AND
ANY SHORELINE SCUM

THANK YOU



Five countries control almost 90% of global phosphate reserves

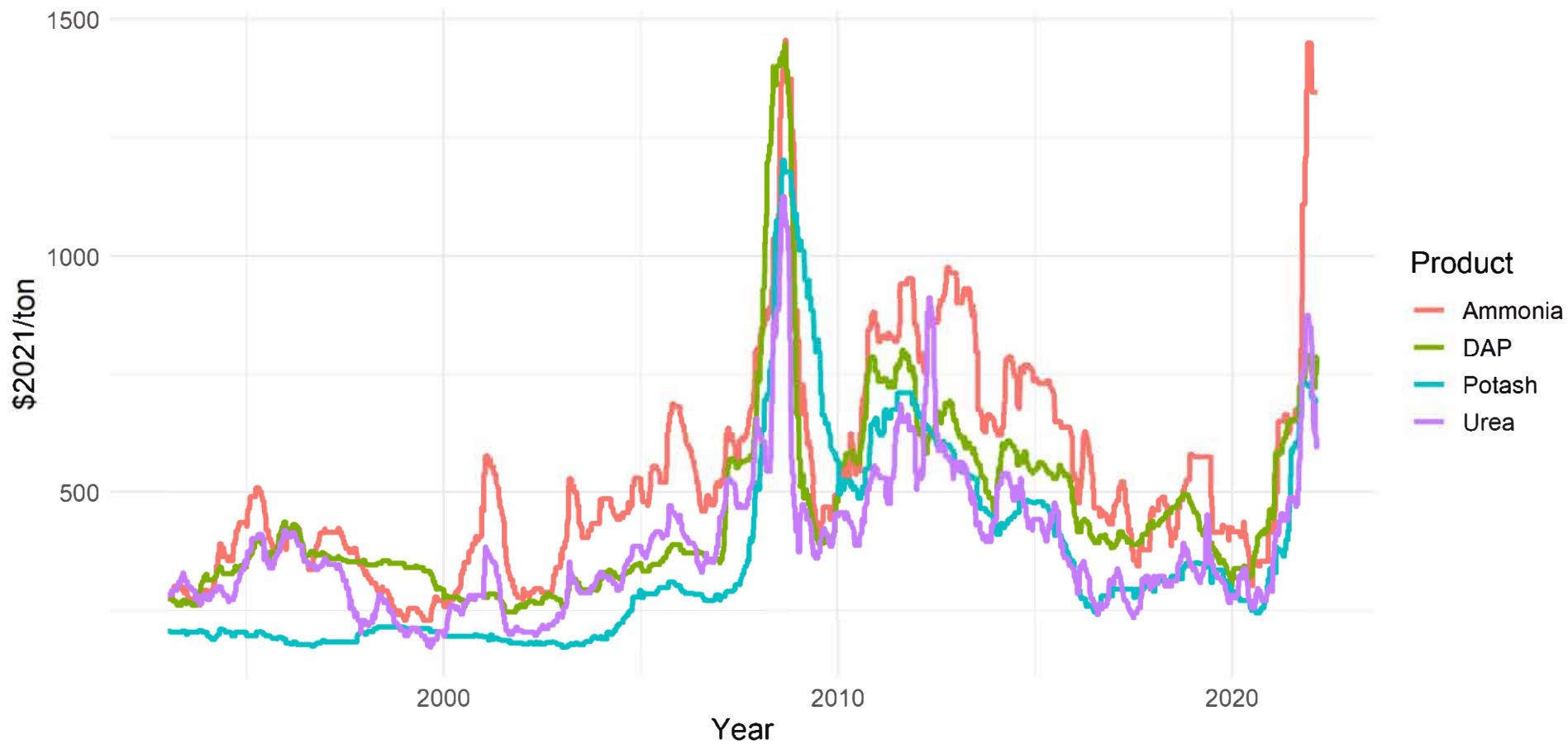


Eight countries account for 65% of global sulphuric acid production





US Cornbelt Fertilizer Prices



Source: Bloomberg

Food riots in 2008

- Egypt Thousands of demonstrators in Mahalla el-Kobra loot shops and throw bricks at police during protests at rising food prices and low salaries, as part of nationwide strike
- Haiti At least four people killed in the southern city of Les Cayes after food prices rise 50 per cent in the past year
- Côte d'Ivoire Police injure more than ten protesters as several hundred demonstrators demand government action to curb food prices
- Cameroon Riots last four days and result in at least 40 deaths. Unrest is due to high fuel and food prices. Worst riots in country for 15 years
- Mozambique At least four people killed and 100 injured following fuel price rises
- Senegal Violent demonstrations in Dakar as prices of rice, milk and oil soar. Senegal imports almost all its food
- Yemen Five days of rioting and a hundred arrests after the price of wheat doubled over two months. Protesters set up roadblocks in Sana'a and Aden
- ...and in Mauritania, Bolivia, Indonesia, Mexico, India, Burkina Faso, and Uzbekistan

- *New Statesman*, April 17, 2008

Approx analysis of the various pollutants and nutrients in waste water. Depends on national diets and washing preferences	Grey	Kitchen			
	Water	Sink Solids	Faeces	Urine	Faeces & Urine together
Based on Swedish Research					
Nitrogen N	7%	8%	15%	70%	85%
Phosphorous P	14%	14%	26%	47%	73%
Potassium K	10%	37%	18%	35%	53%
Faecal bacteria & faecal viruses			100%		100%
<p>Avoiding using phosphorus detergents will reduce the % phosphorus in the Grey Water</p> <p>Avoiding food grinders in the kitchen sink will also minimize N and P nutrients in Grey Water</p>					



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Preparing New Houses using the "HANAPAK" System to prepare for Peak Phosphorus and a future food cost crisis

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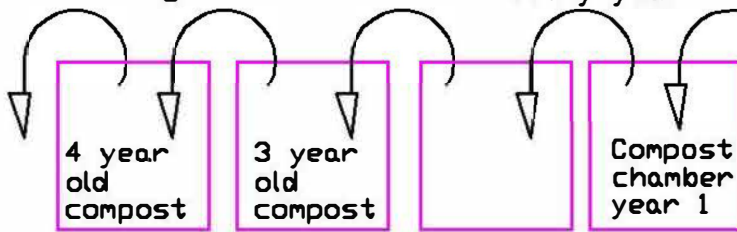
Herr © March 2019

The leaves take up and absorb the nitrogen and phosphorus from urine and also any ingested medicines or pharmaceuticals

Over 4 years of composting the medicines and antibiotics break down in the compost

Add kitchen waste, composted toilet solids, wood sticks and garden leaves

Turn and aerate every year



Concrete composting bins with no less than 4 chambers

Add wood shavings or wood pellets get the pile to heat up.
Add mushroom mycellium
Maximize composting conditions,
Control the moisture in the pile.
Design for long period composting.
Over 4 years any ingested pharmaceuticals will reduce and will naturally break down.

Harvest the leaves



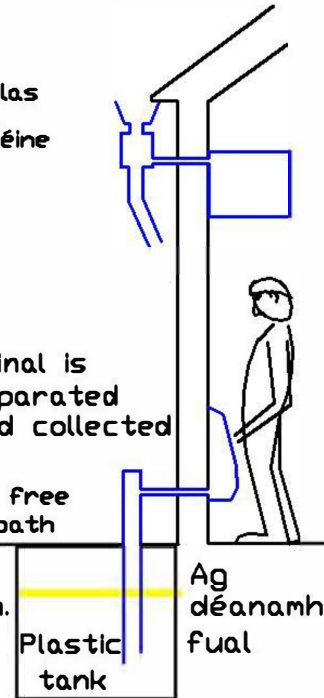
Shallow gravel beds similar to a reed bed type system. See EPA COP Waste Water

weed free footpath



Solas na Gréine

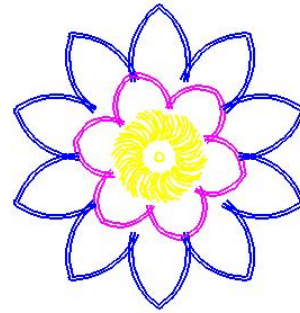
Urinal is separated and collected



Do daoine atá ag súil le ganntanas fosfar agus ardú costas bia sa todhchaí

Ag usáid uisce spéire & fual mar leasachán ar bláthanna agus plandaí neamh-inite .

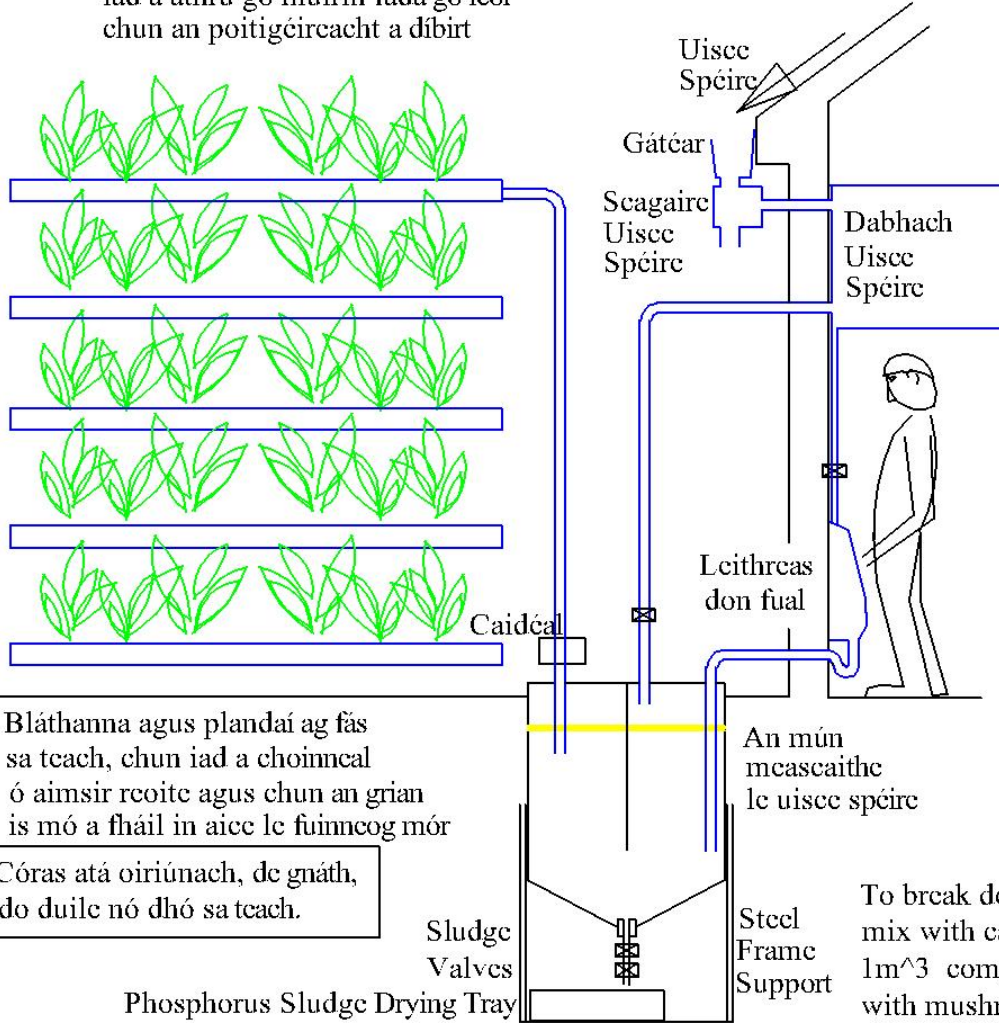
Plandaí ag fás sa griain chun an trualilú a baint as fual.
Na duileoigí a gearadh ansin chun iad a athrú go múirín fada go leor chun an poitigéireacht a díbert



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This system removes almost 80% of nitrogen and 50% of the phosphorus that is present in the urine fraction in domestic wastewater. This can also recycle phosphorus and other nutrients without pharmaceuticals, if composted with mycellium over long enough periods

The plastic containment prevents the nutrients that would otherwise pass down into the soil to be lost and wasted. So often the nitrogen fraction from septic tanks passes through soil, to pollute ground water and the local streams.

Locate the flower/plant growing system, to get plenty of sunlight, inside a warm house, behind large glass double glazed windows

Harvest the leaves and flowers of the plants to remove the Nitrogen and Phosphorus
To break down any pharmaceuticals in the harvested leaves, mix with carbon rich waste, over 3 to 4 years in 4 large 1m³ composting bins, with a year in each bin, ideally with mushrooms growing in the composting material

Bláthanna agus plandaí ag fás sa teach, chun iad a choimeall ó aimsir rooite agus chun an griain is mó a fháil in aice le fuinnog mór

Córas atá oiriúnach, de gnáth, do duile nó dhó sa teach.

Phosphorus Sludge Drying Tray

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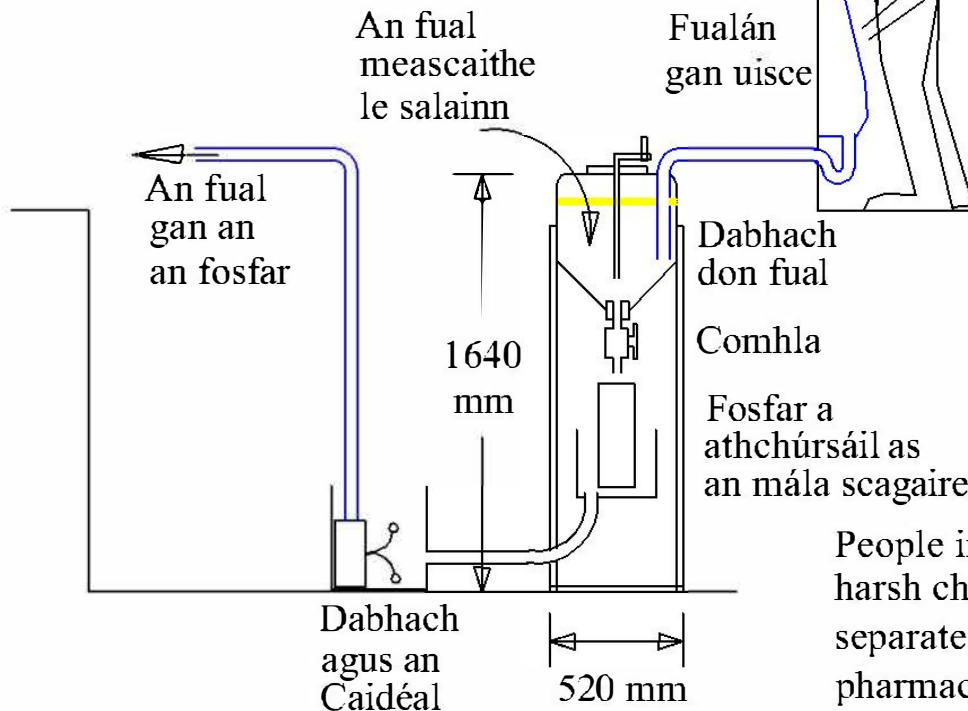
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System elements for phosphorus recycling as struvite.
1 to 3 hrs to operate the process.

Herr system to recover & recycle phosphorus from urine without toxic metals, antibiotics or pharmaceuticals to safely grow vegetables in the garden

With the salt, tiny crystals of Phosphorus are caught in the fine filter bag.
The white crystals of phosphorus need to be dried over the following weeks to remove any remaining pharmaceuticals and antibiotics.



Córas chun fosfar a baint agus a athchúrsáil ón fhuail ó gach pobail & teach

People in their own houses can now easily, and using no harsh chemicals, recover and recycle phosphorus from separated urine without toxic metals, antibiotics or pharmaceutical, as a slow release fertiliser for vegetables.

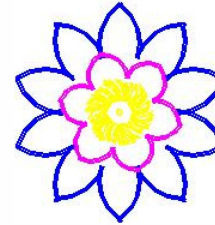
A urine treatment system, adding salt to recycle phosphorus as struvite, and then adding rainwater to grow flowers, to make compost. With long enough composting, pharmaceuticals be removed from the nutrient rich compost

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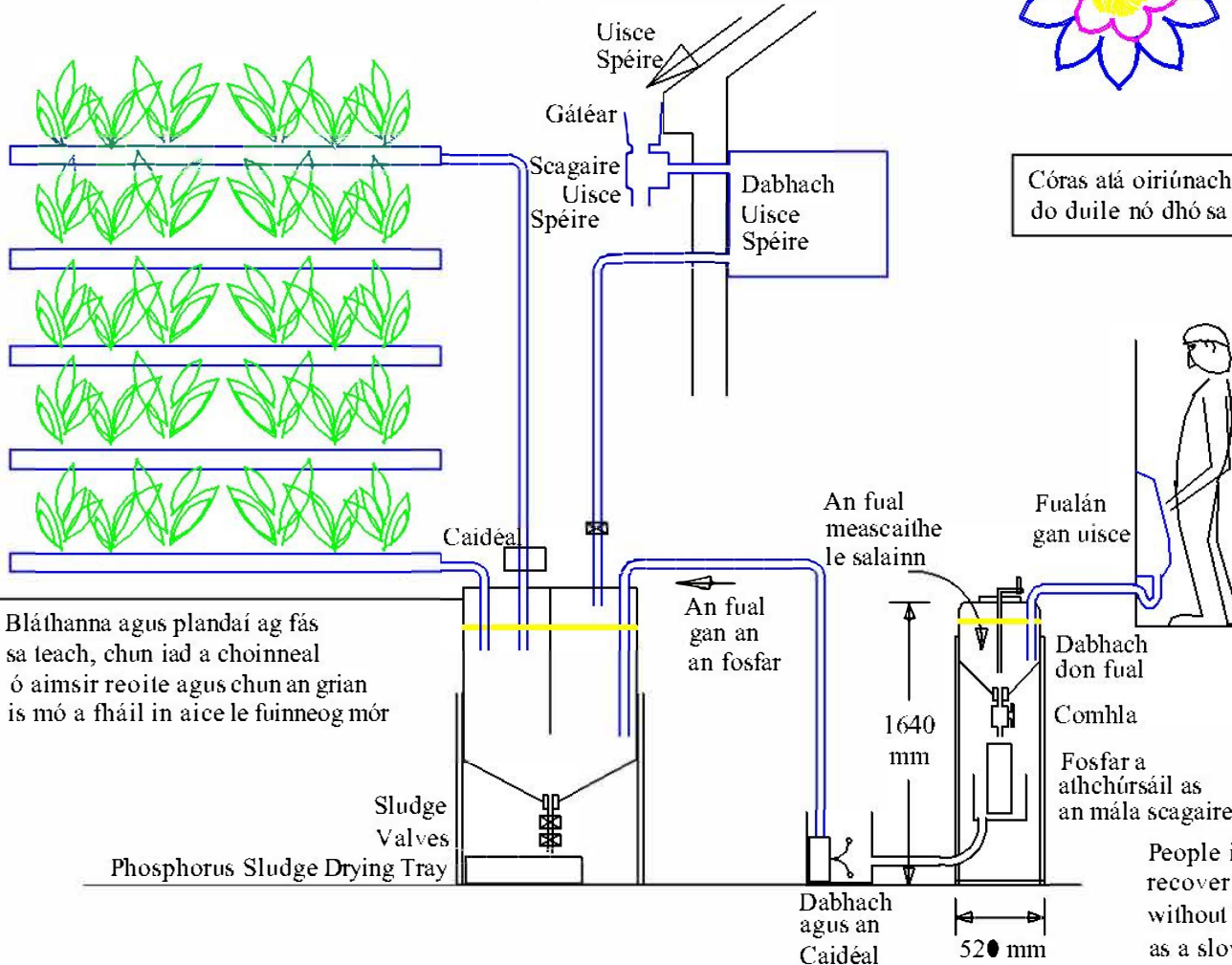
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Córas chun fosfar a baint agus a athchúrsáil ón fhual ó gach teach

People in their own houses can now quite simply recover and recycle phosphorus from separated urine without toxic metals, antibiotics or pharmaceuticals, as a slow release fertiliser for vegetable gardens.



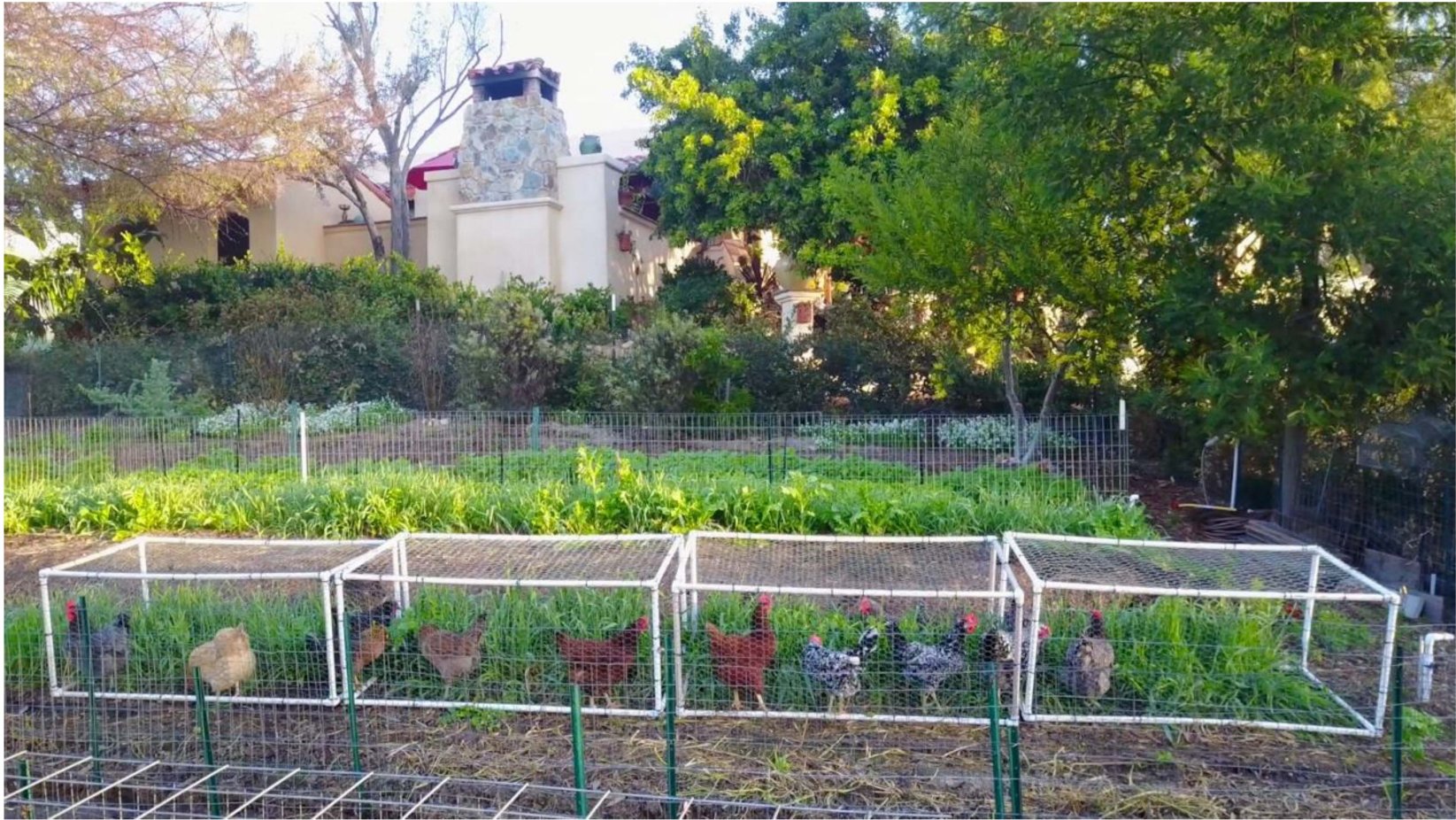
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Sludge Valves
Phosphorus Sludge Drying Tray



Fertiliser and Food price inflation and shortages are now looking very probable

- How badly will future sulphuric acid shortages impact on fertiliser prices?
- How will people manage if the weekly spend for supermarket food becomes unaffordable?
- Will all the possible options for phosphorus recycling be happening at state, community and house level, to avoid a food price/ supply crisis?
- Should we see urine in a new light, as the most economically available phosphorus resource?

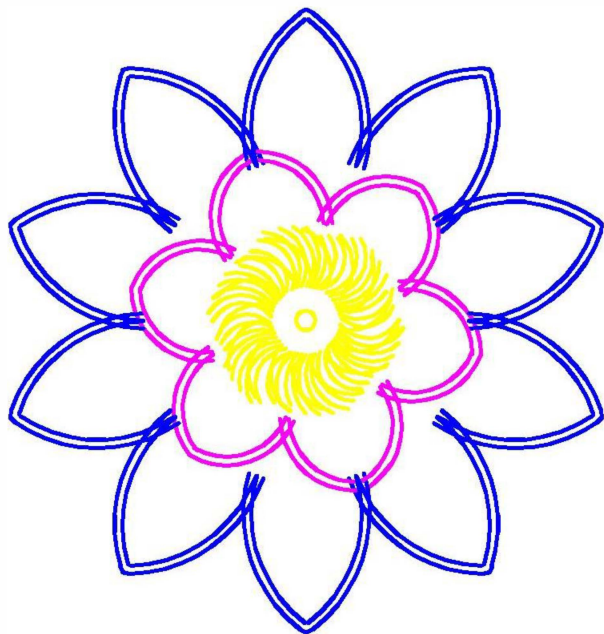








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