



Green Futures

Transition Year Module

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LESSON 3



Sustainable Systems: Energy, Nature, Food and Cities

How the systems we depend on every day connect to climate action and where AI is already changing them.

UNESCO Greening Curriculum concepts: Ecosystems and Biodiversity · Sustainable Lifestyles · Post-Carbon Economies



What you'll learn today

- 1 Describe how energy, nature, food and cities each contribute to climate change
- 2 Compare renewable and non-renewable energy systems
- 3 Explain why biodiversity and healthy ecosystems matter as their own crisis, connected to but distinct from climate change
- 4 Identify sustainable approaches to food, transport and everyday consumption
- 5 See how AI supports smarter, more sustainable infrastructure



SYSTEM ONE

Renewable Energy



- Fossil fuels (coal, oil, gas) release stored carbon when burned; renewables - wind, solar, hydro and tidal do not
- The challenge is not just **generating** clean energy. It is about **storing it** and getting it onto the grid reliably
- AI-supported smart grids help balance supply and demand in real time and optimise where energy goes
- Energy storage (like batteries) is a major area of ongoing innovation
- Read more on [Smart Meter Deployment](#)
- [FREMI project](#) (Forecasting Renewable Energy with Machine Intelligence)
- Watch an example of [AI-driven energy optimisation](#)

Ireland's Energy Transition

- Wind energy is central to Ireland's electricity mix and its expansion is the subject of a genuine, ongoing national debate about where turbines should go and how quickly to build
- Bord na Móna, once one of Ireland's largest peat-cutting companies, has shifted most of its business from peat extraction to renewable wind energy
- This is a useful real-world example of what a 'just transition' looks like in practice, an economy changing direction, and the people within it adapting



SYSTEM TWO

Biodiversity and Nature



- Biodiversity loss is a distinct but overlapping crisis to climate change. Driven also by land-use change, invasive species and pollution, not climate alone
- Nature-based solutions such as protecting and restoring forests, wetlands and peatlands can absorb carbon while also protecting wildlife
- AI supports this work too: satellite imaging and monitoring tools now track deforestation, habitat change and wildlife populations at a scale no human team could manage alone
- Watch video [here](#) on Using Technology to Protect Global Bee Population (Cork)
- Measuring and monitoring biodiversity on and around onshore wind farms: What [Nature+Energy](#) project is and [how does it work?](#)

Ireland's Peatlands: A Distinctive Landscape

- Ireland's peatlands and bogs are internationally significant carbon stores, and distinctive to our landscape
- Bord na Móna's peatland restoration programme is actively rewetting and restoring cutaway bogs, turning former industrial sites back into functioning carbon sinks and habitats
- This **connects** the energy story and the biodiversity story: the same organisation, changing direction on two fronts at once
- Watch video [here](#) on AI2Peat (UCD Research)



SYSTEM THREE

Agriculture and Food Systems



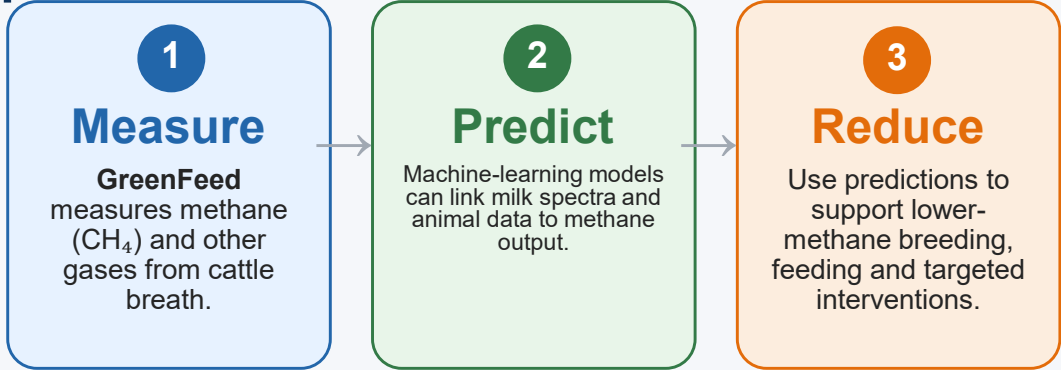
- Food systems are a major source of greenhouse gas emissions worldwide, particularly from livestock and land use
- AI is already used in precision agriculture, predicting crop yields, targeting fertiliser use, and reducing food waste
- [Watch video on Monitoring of Crop Pests HALY.ID](#) (Teagasc)
- An example of how a school project came about by students in TU Dublin. Project [Micron Agritech](#) uses AI for rapid worm testing to fight antimicrobial resistance in animals
- See the project at the [Ploughing Championship](#) too
- Sustainable farming approaches aim to reduce environmental impact while keeping food systems productive and viable

Farming Fairly: Ireland's Beef and Dairy Sector

- Beef and dairy farming is central to rural Ireland's identity and economy and also a major source of national methane emissions
- Teagasc (Ireland's agriculture and food development authority) has set sustainability targets that create real tension for many farming communities
- This is genuinely complex, not a simple 'right or wrong': farmers face pressure from both climate policy and economic survival
- Frame this as a question, not a verdict: 'how do we transition fairly?' - see the [Teagasc AI in agriculture case study](#) for a more hopeful angle on the same sector

AI helps measure and predict where reductions are possible; breeding, feed and management deliver the reduction.

How AI fits into the dairy methane problem



Key teaching point

The AI output is a prediction. The physical reduction comes from an action such as genetics, diet or a methane inhibitor.

Irish AI example

VistaMilk lists research on predicting methane emissions of individual grazing dairy cows from spectral analysis of milk samples.

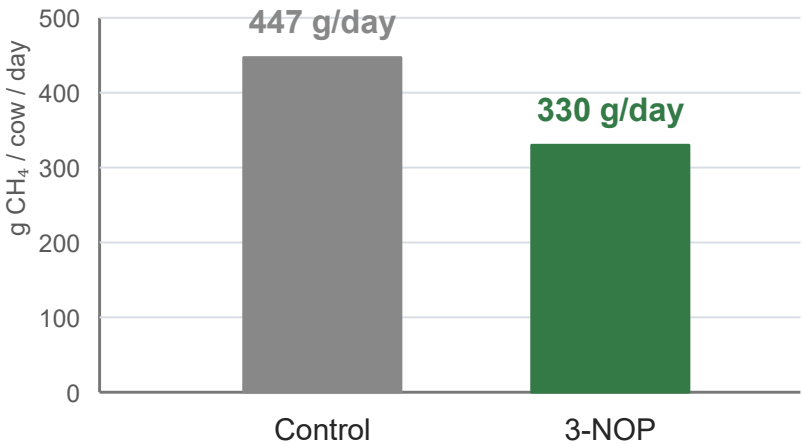
62.5%

of Irish agricultural emissions are enteric methane

1,500+ animals

19 breeds • 11% of methane differences linked to genetics

Teagasc Irish winter-milk trial: methane per cow per day



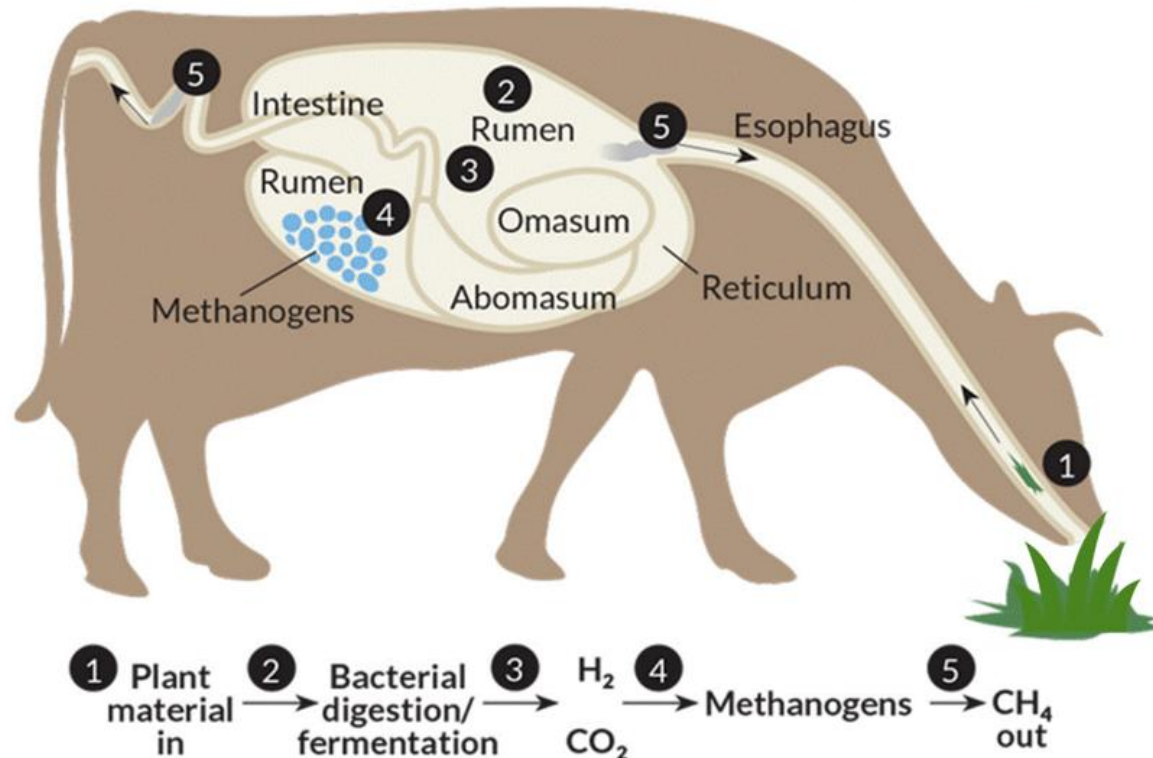
26% reduction

with 3-NOP feed additive

447 → 330 g CH₄/day

AI helps identify which cows, diets or interventions are most promising; the intervention itself causes the methane reduction.

Methane production cycle



- Enteric methane responsible for 60.7% of agri-emissions (EPA, 2022)
- Reductions in methane increase environmental sustainability
- 2-12% gross energy intake loss from methanogenesis
- Additional increase in economic sustainability



SYSTEM FOUR

Sustainable Cities and Consumption



- Transport and urban infrastructure are major sources of emissions and major opportunities for change
- The circular economy: reduce, reuse, redesign, rethink how we make and use things instead of throwing them away
- Our everyday buying choices (clothes, phones, packaging - think fast fashion!) connect directly to circular economy thinking
- AI supports smart cities: optimising traffic flow, public transport routing and energy use across a whole city
- Examples range from [CitySwift](#), partnering with Bus Éireann, [LIFE EMERALD measuring air-pollution](#) to [Artificial Intelligence as an Enabler of the Circular Economy](#)

Irish Cities in Transition

- Dublin has seen a major shift toward cycling infrastructure, Luas expansion and improved bus connections in recent years
- Dublin has also piloted AI-powered smart-city traffic systems, working with technology partners to optimise traffic flow in real time.
- Together these show a city actively experimenting with both infrastructure and technology to become more sustainable
- [Watch a video on Dublin's Travel and Road Safety. AI Smart City](#)

Weigh the Trade-Off

1. In small groups, take one system from today's lesson: energy, farming, or transport
2. List one clear benefit and one clear trade-off/cost of the sustainable option (involving AI) in that system (e.g. wind energy: clean power vs. visual/land-use impact)
3. Decide as a group: on balance, is it worth it? Be ready to defend your reasoning
4. Quick self-check: did your group consider more than one perspective (e.g. environmental, economic, and community)?

APPLY IT

🕒 ~8 minutes



Improve a System Close to You

Pick one system - energy, food, transport or waste - in your own school or town. Identify one realistic improvement that could make it more sustainable, and one thing that would need to happen to make it work.

How they show their work: Students sketch or write their proposal in their climate journal - a short paragraph or annotated diagram.

What have we learned?

- ✓ We've connected energy, nature, food and cities to climate action
- ✓ We've seen real Irish examples of sustainable transition and the trade-offs involved
- ✓ We understand where AI already supports smarter, more sustainable systems
- ✓ We've proposed one realistic improvement to a system close to home

Next lesson: we turn to climate justice, the future, and how we can all be part of the response.

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See you in Lesson 4: Climate Justice, Futures Thinking and Green Innovation

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