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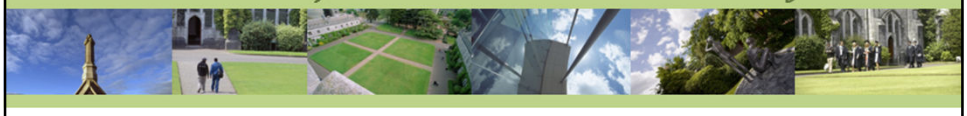

Sustainability and Progress:

Building Adaptability, Resilience & Creativity into Complex Socio-Technical Systems

Dr Edmond Byrne
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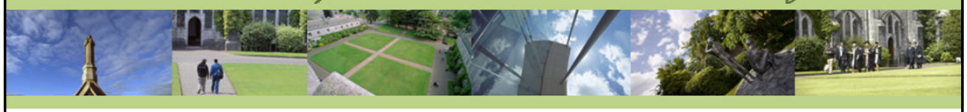
The Free University' – ACE @UCC Public Lecture Programme



Considering

Progress

and

Sustainability..

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E.P. Byrne & G. Mullally, University College Cork, 9 April 2014

Modern conceptions of **PROGRESS**, based on the dominant Cartesian reductionist paradigm, are associated with a linear drive towards ever greater ascendency, order, organisation, homogeneity, hegemony, performance, efficiency and control.

'American Progress' (John Gast, 1872)

..and towards extinguishing disorder, inchoateness, uncertainty, redundancy and risk. This is an antagonistic dualistic reductionist framework, an 'either-or', 'for or agin', black or white, which envisages progess as a linear process of optimisation.

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Contemporary conceptions of **SUSTAINABILITY & SUSTAINABLE DEVELOPMENT**, framed within this paradigm, *align* with such ideas of '**PROGRESS**'. Sustainability itself is seen as an unending process characterised by greater efficiency* and control, realizable for example through technological prowess, more organisational structure, utilization of 'smart' systems, 'big data' and risk extinction. Such increased ascendancy can, it is envisaged, even build system resilience.

'American Progress' (John Gast, 1872)

*Jevons' paradox is conveniently overlooked.

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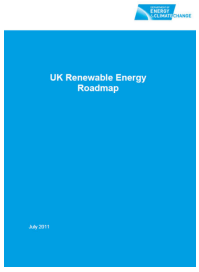
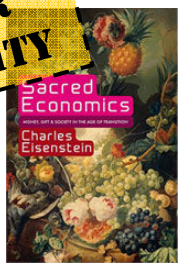


UK Renewable Energy Roadmap, Dept. of Energy & Climate Change (2011)

"We also recognise the need to reduce demand. Energy efficiency is the most cost effective way of closing the gap between supply and demand, which is why we have launched the Green Deal and the roll out of smart meters in Great Britain."

Charles Eisenstein, Sacred Economics (2011)

"More efficient production technology allows us either to work less or to work just as hard and produce more stuff. Our economic system requires and embodies the latter choice."



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Sustainability

John Ehrenfeld (2008):

*"**Sustainability** is the **possibility** that humans and other life will flourish on Earth **forever.**"*

Ehrenfeld (2013): '**Flourishing** is nothing more than a state recognized when one says: "All my **cares** are being **satisfied**, at least for the moment."'

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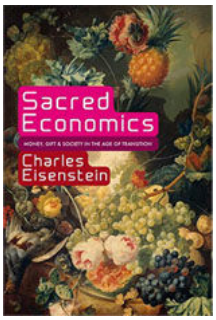
Charles Eisenstein (2011):



*"We have lived in an **Age of Separation**.*
One by one, our bonds to community, nature, and place have dissolved, marooning us in an alien world.
The loss of these bonds is more than a reduction of our wealth, it is a reduction of our very being. The impoverishment we feel, cut off from community and cut off from nature, is an impoverishment of our souls.

That is because, contrary to the assumptions of economics, biology, political philosophy, psychology, and institutional religion, we are not in essence separate beings having relationships. We are relationship."

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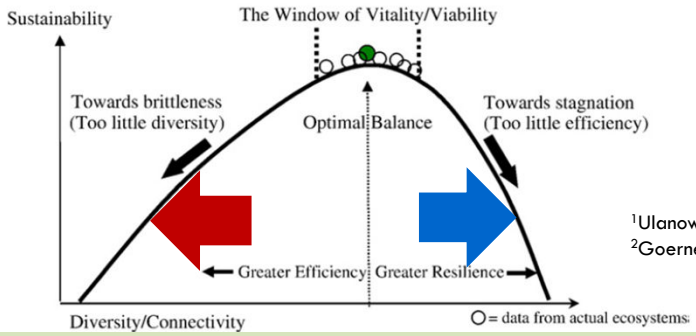
An alternative conception of **PROGRESS** to the dominant emerges via systems ecology, where it has been quantitatively[1] shown that sustainable ecosystems maintain a dynamic balance between opposing but necessary tendencies of ascendency/efficiency and redundancy/creativity (a complimentary dualism).



[1]Ulanowicz, 2009
[2]Goerner et al., 2009

Sustainability as a dialectical balance between control/efficiency and redundancy/creativity[2]

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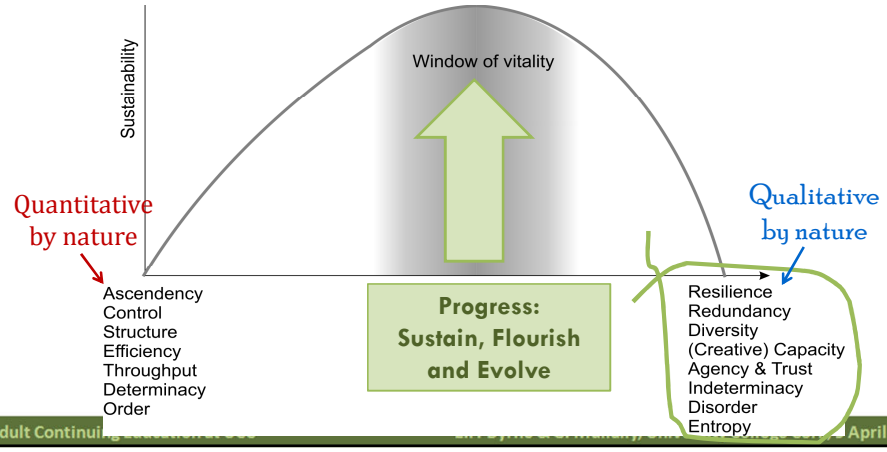
Modern (linear) conception of PROGRESS [1] *versus* a natural requirement for PROGRESS which involves *CONTINGENT BALANCE* [2] among complex (eco-/bio-/socio-/socio-technical/economic) systems



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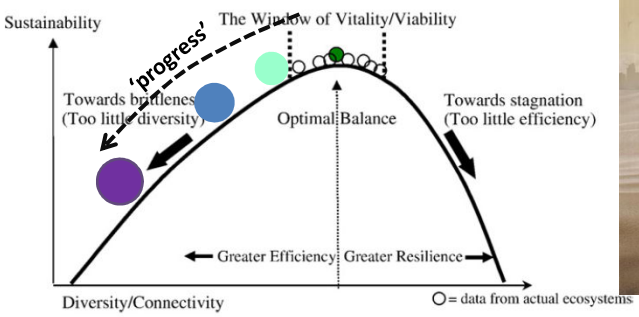
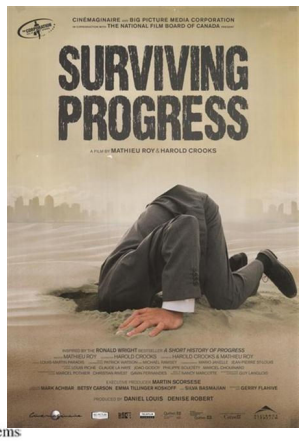
'Systems can become too efficient for their own good' **(Ulanowicz, 2009)**

While systems tend towards **greater ascendancy,** and are **favoured** over **competing** systems, they are also **less resilient** and **adaptable** and are subject to **collapse** as they fall into what Wright calls a '**progress trap**'





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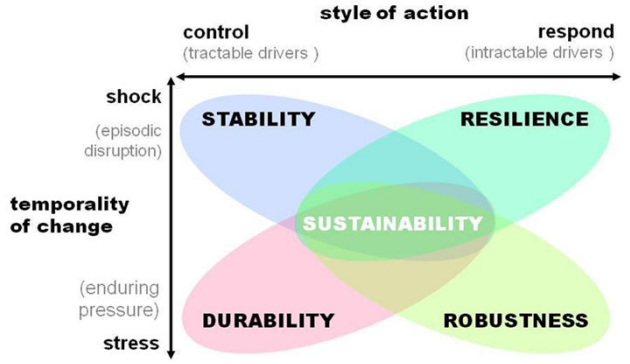
This model has been applied and adopted in relation to sustainability across techno-economic and social domains[3,4]



[3]Goerner et al., 2009
[4]Stirling, 2011

'*Four necessary but individually insufficient dynamic properties of sustainability*' (Stirling, 2011)

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'Progress traps' across human history

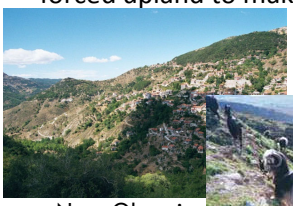
The virtual extinction of the **woolly mammoth** about 10,000 years ago - chiefly through **human hunting**, exacerbated by **climate change**, and the extinction of other large animals ended big game hunting society.

"Paleolithic hunters who learnt how to kill two mammoths instead of one had made progress. Those who learnt how to kill 200 – by driving a herd over a cliff had made too much.
..The hunters at the end of the Old Stone Age ..broke rule one for any prudent parasite:
Don't kill off your host. As they drove species after species to extinction, they walked into the first progress trap." (Wright, 2005)

'Progress traps' across human history

Extensive environmental degradation in:

- **Ancient Greece** (**hills** denuded of trees from goat grazing as farmers forced upland to make way for urban growth, resultant soil erosion).



Near Olympia, Greece

Sacred Mount Athos, Greece

Cedars of Lebanon; Bcherri Grove

- **Rome**: end of the **forests** of S. Italy by 300BC, environmental degradation around Rome; grain imported from Roman Syria, Tripolitania (Libya)

Roman agricultural city of Ghirza, Libya, now desert

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'Progress traps' across human history

- Collapse of the central American **Mayan** civilisation ca. **900 AD** amid environmental degradation exacerbated by a changing (dryer) climate

- Transformation of China's **Loess Plateau,** home of several dynasties, from rich forest and grassland to vast bare degraded wasteland by **1000AD**. Most **eroded place** on earth: 1 billion tonnes pa soil washed down the Yellow River

- Rapid population collapse on **Easter island** in the **17thC** after all the island's trees had been cut down.

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'Progress traps' across human history

Environmental degradation resulting from increased societal ascendancy: England's 'black country' in the 19th Century at height of Industrial Revolution.

Airpocalypse as pollution index goes from 'crazy bad' to 'unhealthy', then 'beyond index'

Irish Times, 16 January 2013

Clifford Coonan Beijing Letter

hazardous, while "beyond index" is above 500. The reading was "beyond index" for 16 hours in a row at the weekend.

Even the normally cowed local media didn't bother with the usual euphemisms such as "fog". They gave charts of where the smog was thickest and warned people to stay indoors in no uncertain terms. School-children were not allowed

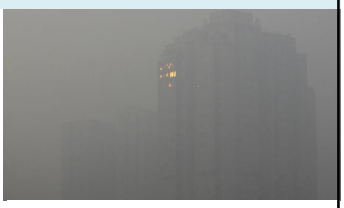
years, with major pollutants down in the city. Then, last week, it quoted officials saying that Beijing would "continue to lower emissions of major pollutants" and that last year's targets had been met. No one believes it.

With 400,000 new cars taking to the streets every year and with the permanent population increasing by 400,000 people every year, it's

Another made the point, however, that western countries were free of environmental problems because they exported them all to China.

"Go to a US supermarket and you'll see how all the paper, all the chopsticks, all the wooden furniture, even the toothpicks, are made in China."

The European Commission estimates that China produced 9.7 million kilotons of carbon



Beijing by day, 12 Jan. 2013

Today, world's manufacturing base has largely shifted to China with globalisation: and with it some of the earth's worst environmental degradation. Smoggy cities like Beijing regularly go 'beyond index' on air quality standards.

Tropical forests in the Amazon, Indonesia are being progressively destroyed.

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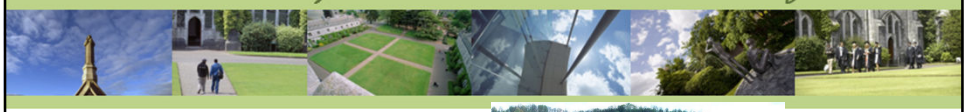

Some examples:

Intensive industrial/monocrop agriculture

Diffuse microgeneration and distribution of electricity

Sustainability

Globally centralised lean manufacturing ***versus*** localised and artisan production

Hegemonic globalisation ***versus*** local economic subsidiarity

'Survival of the fittest' individualism ***versus*** interconnected social solidarity and cohesion

IPAD THEREFORE IAM

The dominant monist, linear conception of progress which seeks optimisation through competition, separation, efficiency and growth is problematic because:

- It does not concur with a reality which envisions (eco-/scoio-/techno-economic) system sustainability and evolutionary progress as a dialectic dynamic *balance*.
- It is incapable of *recognising bio-physical limits* – instead promoting increased consumption.

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CASE Study: EU Energy Policy

EU 20-20-20 Goals (by 2020):
- Source 20% of energy from renewables
- Reduce GHG emissions by 20%
- Reduce energy consumption by 20% (of projected 2020 levels) (exclusively through increased energy efficiency)

State of play in the EU energy policy (European Commission,2010):
"It is widely recognized that at least 20% of EU's primary energy demand (or 368 Mtoe) can be reduced by 2020 compared to business-as-usual PRIMES scenario of 2007 with cost-effective measures."

Ireland's contribution: The National Energy Efficiency Action Plan 2009–2020

"The purpose of the Action Plan is to chart a path towards achieving a 20% reduction in energy demand by 2020. (Compared to average energy use over the period 2001 – 2005)."

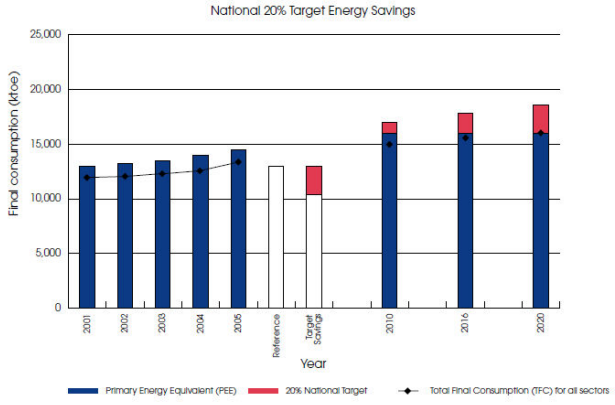

Figure 19: Illustration of Target Energy Savings against Final Consumption

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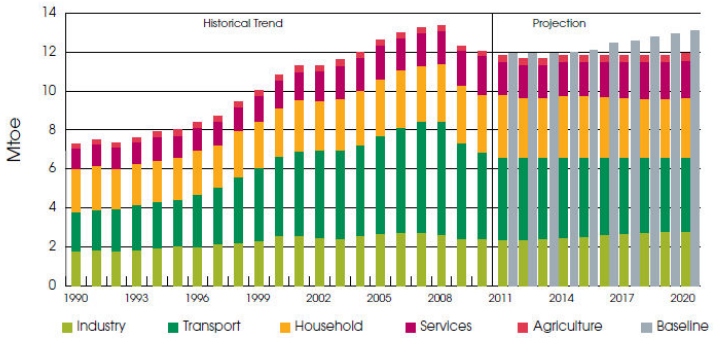
Ireland's contribution: 2nd National Energy Efficiency Action Plan to 2020

"The Government has committed to achieving, by 2020, a 20% reduction in energy demand across the whole of the economy through energy efficiency measures."

Figure 3: Total final demand by sector (NEEAP/NREAP scenario)



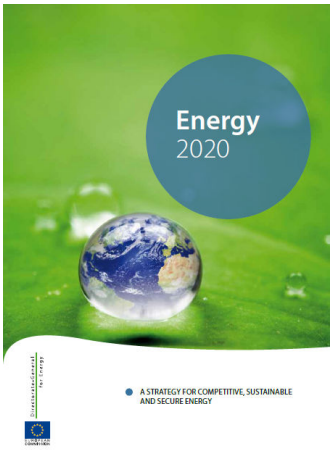
Progress on EU Energy Policy towards '-20%' Demand

Energy 2020 A strategy for competitive, sustainable and secure energy (EC, 2011)

"We are **a long way** from achieving the 20% energy savings objective.

The EU needs to develop a new energy efficiency strategy which will enable all Member States to further decouple their energy use from economic growth.

It is necessary to address the paradox* whereby demand for more energy-intensive or new products outstrips gains in energy efficiency. It is high time for us to move from words to actions. Thus, energy efficiency needs to be mainstreamed into all relevant policy areas, including education and training, to change current behavioural patterns."



* 'Jevons Paradox'

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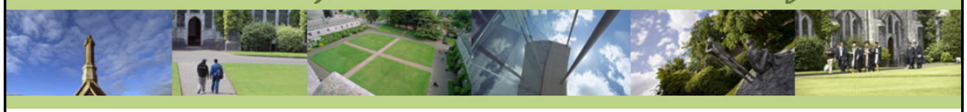
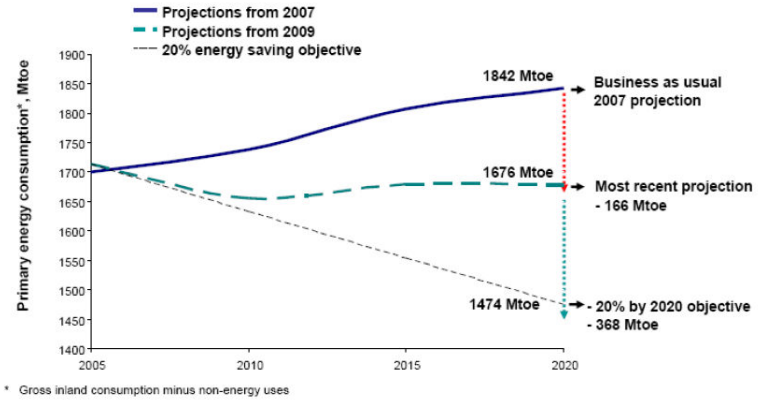


Progress on EU Energy Policy towards '-20%' Demand



* Gross inland consumption minus non-energy uses

Source: EU Commission (June 2011)

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Progress on EU Energy Policy towards '-20%' Demand

A policy framework for climate and energy in the period from 2020 to 2030 (EC, 2014))

"Currently, a shortfall against the 20% target is predicted.
[Following a] review ..the Commission will consider whether it is necessary to propose amendments to the Energy Efficiency Directive.
..The review will also consider whether energy intensity improvements ..represents a better benchmark upon which to frame a 2030 objective.

eurostat newsrelease

25/2014 - 17 February 2014

Energy – 2012 data

Energy consumption down by 8% between 2006 and 2012 in the EU28

Nuclear power and renewables made up half of the energy production

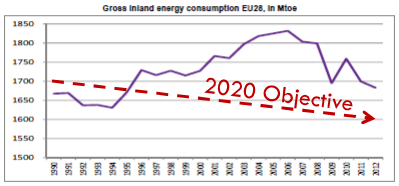
Over the last two decades, gross inland energy consumption[1] in the EU28, which stood at 1 670 million tonnes of oil equivalent[2] (Mtoe) in 1990, rose to a peak of 1 830 Mtoe in 2006 and then decreased to 1 680 Mtoe in 2012. Between 2006 and 2012, gross inland energy consumption in the EU28 has fallen by 8%.

The energy dependence rate[3], which shows the extent to which a country is dependent on energy imports, was 53% in the EU28 in 2012.

The domestic production of primary energy was 794 Mtoe in the EU28 in 2012. Nuclear energy (29%), accounted for the largest share, followed by renewables[4] (22%), solid fuels (21%), gas (17%) and oil (10%).

These figures are issued by Eurostat, the statistical office of the European Union.

Gross inland energy consumption EU28, in Mtoe



Gross inland energy consumption fell in twenty four Member States between 2006 and 2012

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Energy generation and distribution policy in Ireland

Context: A highly complex socio-technical system

"The extent of interconnectedness, like the number of sources, controls, and loads, has grown with time. In terms of the sheer number of nodes, as well as the variety of sources, controls, and loads, electric power grids are among the most complex networks ever made." (Amin, 2011)

EU 20-20-20 Goals (by 2020):
- 20% of energy from renewables
- Reduce GHG emissions by 20%
- Reduce energy consumption by 20%

Informed by Dominant Conception of Progress:
-top down planning, corporate projects
-renewables and efficiency
-efficiency

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Separation between local (generation and distribution) and:
- corporate elites and
- distant end users

Energy Use Implications: Overall Consumption **increases** as renewables supplement other energy sources

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Alternative conceptions; alternative options?

"It is possible to identify two ends of a spectrum of innovation for sustainable development that focus on distinct actors, mechanisms, and knowledges.

Green Industrialisation
"led by large firms, or by public-private partnerships of multinationals and governments advocating a science-push and top-down form of STI[1]."

Grassroots Innovation
"rooted more centrally in civil society, and argues for a more participatory, bottom-up form of knowledge production and innovation for sustainability that responds to local situations and the interests and values of the communities involved. This approach ..seek[s] deeper, alternative forms of sustainable development-forwarding a more transformative agenda around the reorientation and transformation of sociotechnical systems. (Leach et al, 2012)

[1 science technology and innovation]

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Alternative conceptions; alternative options?

"Smaller scale technologies like PV can show quick rates on innovation and can be quickly deployed and improved. Collectively these supply chain issues can impact deployment rates and therefore the potential role of these technologies in bringing about a low carbon transition whilst also ensuring energy security. Arguably, then, from an energy security and low carbon transition perspective, there is something inherently more secure about smaller-scale technologies.

Currently this sort of analysis is not considered by policy-makers within the UK, but given the multiple challenges in bringing about a low carbon transition, such an approach could better help to identify where support should best be directed. This is more likely to enable a transition that is rapid, sustainable, secure and affordable and it deserves more policy attention." (Hoggett, 2014)

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Alternative conceptions; alternative options?

Carley & Andrews (2012):

Additional potential benefits to energy systems based on locality:

- Can be designed to match local demand (reduces transmission costs, losses)
- Increase local control over energy supply (social equity)
- Reduces negative externalities (e.g. those living near get benefits of use)
- Create local market opportunities (jobs, entrepreneurship)
- Potential for more closely aligned supply- and demand-side operations

'the presence of local energy systems, and possibly also individuals' control over these systems, causes consumers to change their energy behavior or patterns.'

'A more local scale and ownership of energy systems may provide a sense of empowerment and contribute to lifestyle decisions based on the environmental ethics, including demand-side behavioural adjustments. ..large facilities also are often initially overbuilt in order to anticipate future demand growth, they also create pressures to promote more rapid demand growth in order to more fully utilize them'

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Alternative conceptions; alternative options?

Templederry Wind Farm, Co. Tipperary – local creativity

John Fogarty, Director, Templederry Wind Farm
"The key is that a large amount of the money should stay within the community. What we hope is that the government would streamline some of it. If a community came together and worked with the planners, we might be able to find a solution that suits everyone."

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Alternative conceptions; alternative options?

Templederry Wind Farm, Co. Tipperary

Paul Kenny, Tipperary Energy Agency
"The bottom line is that the negative lobby has been driven by fear of the very big projects that have very little community input or gain. There was no issue before the big projects came on stream, and what people are attacking is wind energy, but what they should be attacking is corporate dominance over our energy supplies."

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Alternative conceptions; alternative options?

Templederry Wind Farm, Co. Tipperary

Pat Rabbitte, Minister for Energy, Opening Templederry WF, 16 Sept. 2013
"While the debate continues over how best to tackle rising energy costs, insecurity of supply, and the obvious downsides of a carbon driven energy sector, it has become increasingly apparent that **what is needed is a broad mix of both top-down and bottom-up initiatives.** The Templederry project is, I believe, a template for the future and I fully expect to see many more of these community led projects, where **local people seize the initiative** in powering Ireland for the 21st Century."

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Alternative conceptions; alternative options?

"These two approaches [*green industrialisation and grassroots innovation*] are ..best understood as 'ends of the spectrum', within which a range of hybrid possibilities lie."

Cooperatively owned wind turbines pioneered in Denmark have been superseded by large utility-owned and investor-owned wind parks. ..[yet] community-owned energy projects are growing in popularity in some locations, such as 'citizens power' movements in the US and Europe.

These examples ..transcend the grassroots–green industrialisation dichotomies above by being the product of both community-level ingenuity and industrial technologies, being driven by both the profit motive and social values, and by drawing on multiple forms of knowledge-both technical and nontechnical-and recombining them to produce new ways of responding to sustainable development challenges."
[Leach et al, 2012]

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Alternative conceptions; alternative options?

"From an overall system's perspective, with goals of increased efficiency, sustainability, reliability, security and resilience, we need both:

a. Local microgrids (that can be as self-sufficient as possible and island rapidly during emergencies), and

b. Interconnected, smarter and stronger power grid backbone that can efficiently integrate intermittent sources, and to provide power for end-to-end electrification of transportation."

(Amin, 2011)

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Sustainable Energy Spectrum Model of Carley and Andrews (2012)

"We propose the concept of a "sustainability electricity scale spectrum" composed of a combination of traditional macro-generation facilities with increased integration of…"

Macro-generation	Micro-grids	Distributed generation	Micro-generation	End-user conservation and efficiency
Large (inter-)national transmission systems over great distances from large, often distant central-station generating plants. Energy losses (~ 6.5% USA, 2007) could be significantly reduced by more local generation.	Relatively small, low voltage distribution networks; housing estates to municipal applications. Self-controlled, semi-autonomous connected to the central grid but easily isolated to serve as an islanded electricity system.	Generally refers to generating systems that produce between 5 kWand 5 MW of power; e.g. Combined heat and power (CHP)	Small-scale generation (< 5 kW) e.g. PV, solar thermal, hydrogen fuel cells, wind, CHP. Usually owned by end-users, to generate a portion or the entirety of their domestic household needs.	Includes both passive and active energy-efficiency technologies that reduce total electricity demand, as well as changes in electricity consumption behavior.

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Carley and Andrews (2012):

Why then do we not already have a more fully sustainable multi-scale spectrum of electric generating units?

1. –economics (economies of scale, large investments in existing infrastructure)

2. –institutional inertia

Another factor?
Government inertia (EU, national, local) due to blinkered policy fixation on macro-generation, which in turn emanates from a linear conception of socio-technical progress which seeks control, ascendancy, growth, scale, efficiency, but which ultimately leads to reduced resilience and security, increased separation and consumption and unsustainability.

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