Scale Conflicts in Renewables' Deployment

Distributed Generation as a Common Pool Resource

Guest Lecture
KlimaCampus
Hamburg
22 May 2014

Maarten Wolsink
Department of Geography, Planning & International Development Studies

University of Amsterdam

1984-86 first research on social acceptance ("non-technical factors") Durgerdam and Camperduin (NL) Some significant results still valid

Framing social acceptance and conflict. Example: AR5 IPPC 2014 on renewables' deployment

Ch7, p16, 17, 76

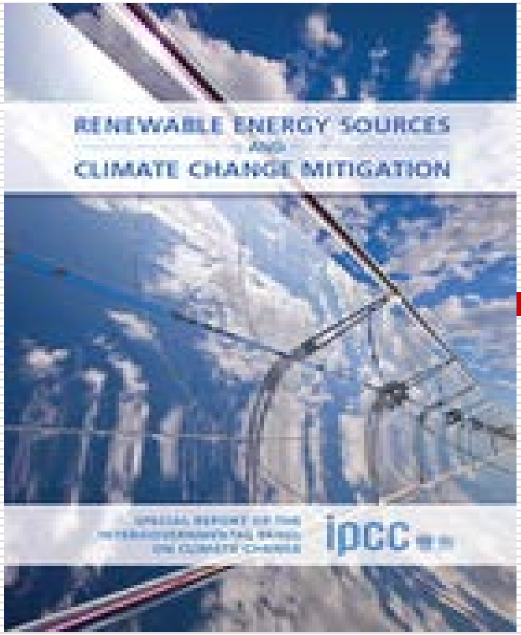
- technical potential estimates do not seek to address all *practical or economic limits* to deployment
- *Framing:* many of those *additional limits* (……) are discussed elsewhere in Chapter 7
- economic factors, environmental concerns, *public* acceptance, and/or the infrastructure required to manage system integration ….. are likely to limit the deployment of individual RE technologies *before* absolute technical resource potential limits are reached
- The contribution of mitigation technologies depends on site- and context-specific factors such as resource availability, mitigation and integration costs, *co-benefits/ adverse side effects*, and *public* perception

Framing continued

AR5 IPPC 2014 on renewables' deployment

Ch7, p16, 17, 76

- "Cultural, institutional, and legal barriers and opportunities"
- Significant social and cultural barriers facing renewable power systems "*as policymakers* continue to frame electricity generation *as a mere technical challenge"*
  Sovacool, 2009
- "despite the historic success of FITs, there is a tendency to shift to tender-based systems because guaranteed tariffs without a limit on the total subsidy are difficult to handle in government budgets" Halsnæs et al., 2012, p. 6



IPCC report on RE and mitigation (2012)

- involving the community in the planning and siting process improves outcomes
- Involvement community-based organizations mitigates local opposition to RE installations
- Facilitating local ownership / sharing benefits
- Attitudes have been found to improve when the process is perceived transparent
- Allowing the community to influence decisions upon wind power plant and turbine locations
- Rights for all to feed-in to grid and risk reduction favours local ownership and control of RE systems (usually by FIT)
- Local ownership ... and other benefit-sharing mechanisms ... can improve attitudes towards wind energy development

IPCC 2012 p757-906

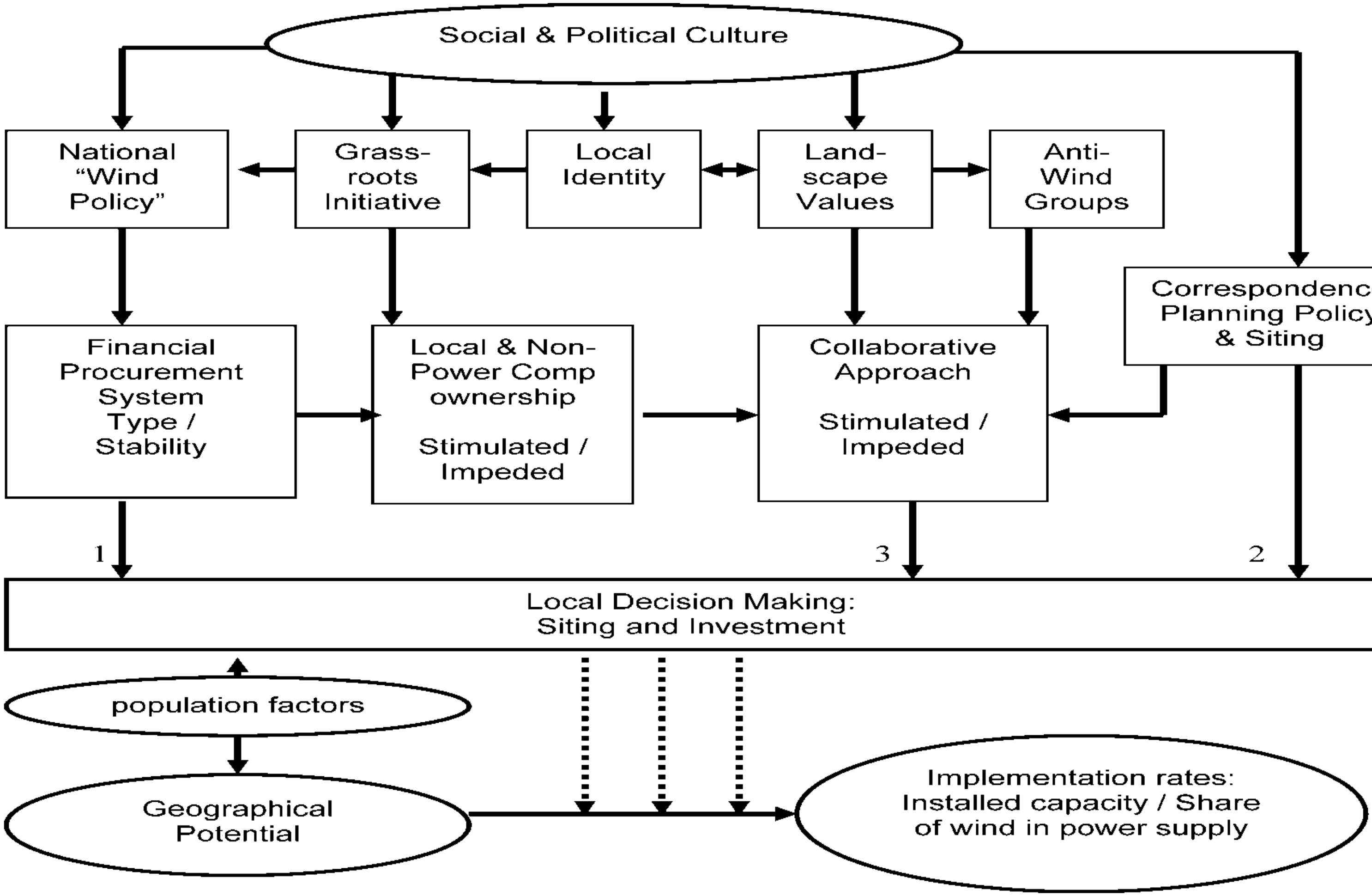
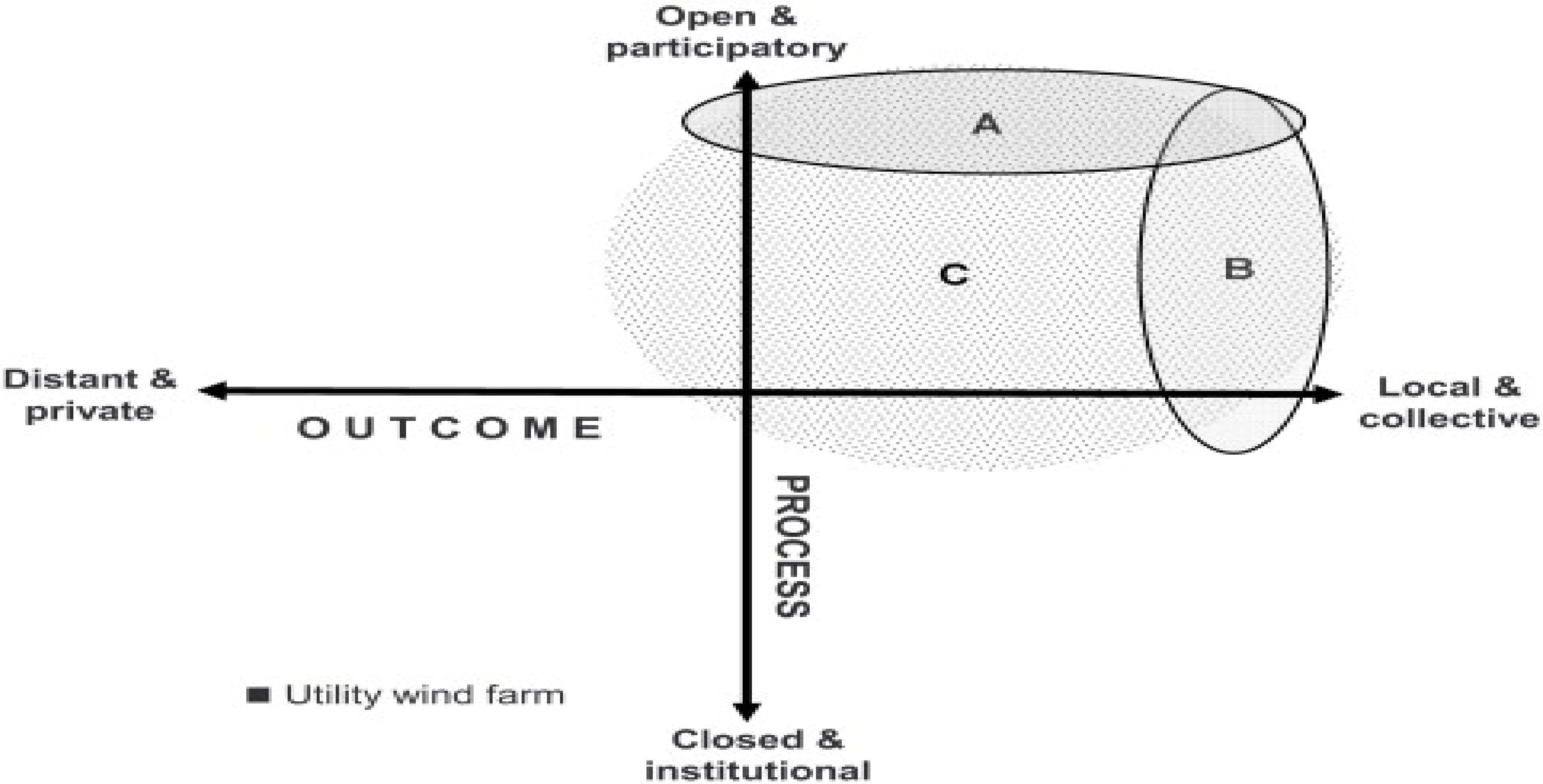


Figure 3. Overview of institutional factors affecting the decisions about wind power implementation (adapted from 47, 108).

Wolsink, 2013. *Encyclopedia of Sust Science and Techn,* adapted from Toke et al. 2008 *Renew & Sust Energy Reviews* 12, 1129

Example collaborative decisions in investment and siting RES projects; 2 dimensions:

●in the project ● in decision-making



Walker, Devine-Wright 2008 *Energy Policy* 36, 497

Social acceptance in innovation

- Many conflicts between scales

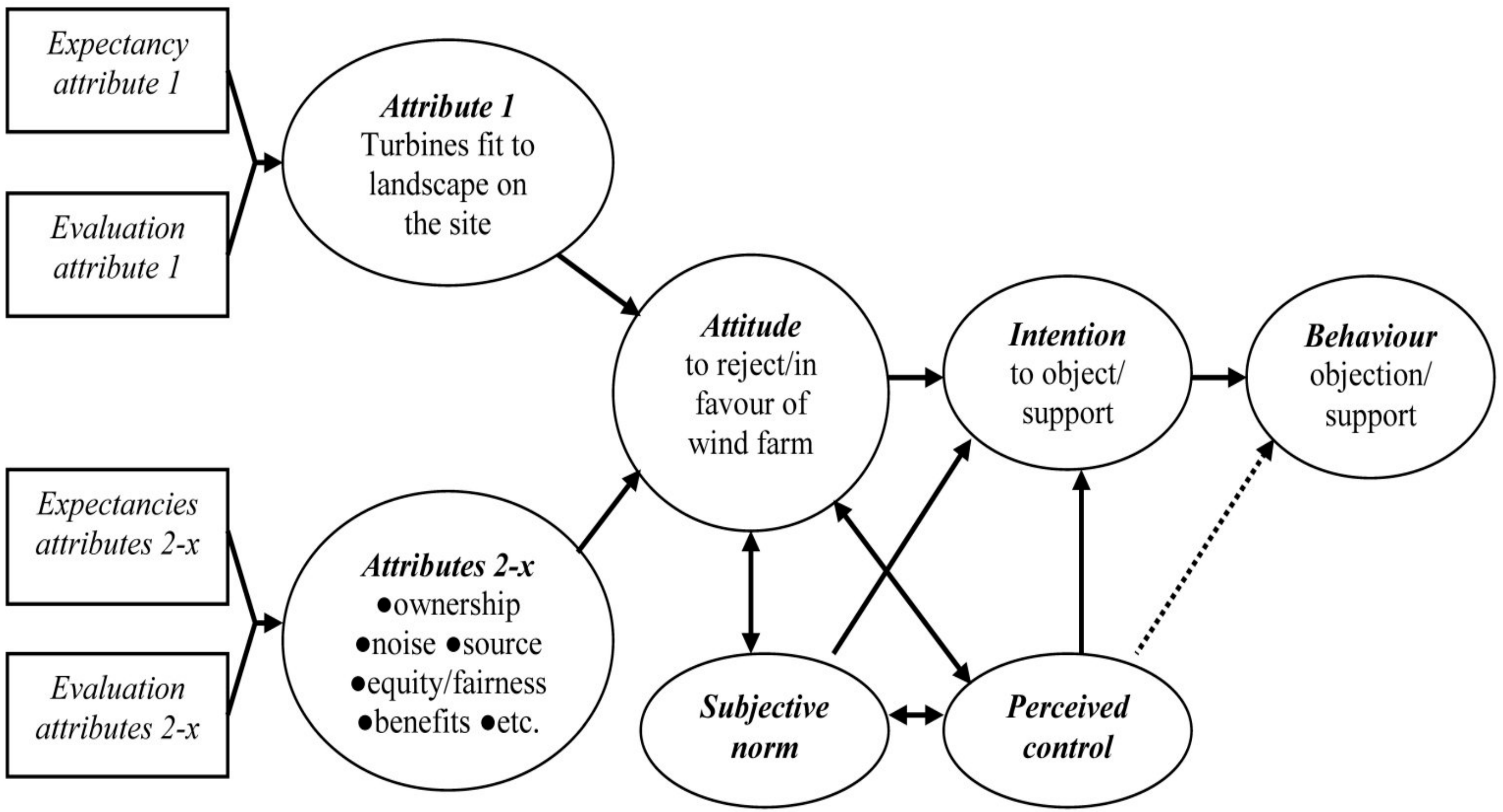
- All conflicts are related to institutional setting

Wüstenhagen et al 2007. *Energy Policy* 35, 2386
adapted Wolsink 2013 EDI Quarterly 5, 10

Some state-of-the-art fundamentals

- *Social* Acceptance ≠ *Public* Acceptance
- Acceptance *wind energy*
  ≠ Acceptance *Wind energy projects*
- Barriers to deployment NOT primarily related to local opposition (community acceptance)
- Basics acceptance wind/solar/marine similar; *Societal actors and their interests different*

Attitudes: expectancies and values of **attributes** of an **object of behaviour**; “Theory of Planned Behaviour” (Ajzen 1991; applied to wind power: Wolsink 1990)



Subjective norm: perceived expectancies of important 'others'
Perceived control: control of the individual over behaviour and its aims.

Attitude object: Wind as Source / Power Supply with substantial amount of RES

Essential characteristics	Associated Attributes
• Environmentally benign, renewable	Alternative to fossil Alternative to nuclear Source can't run out
•Supply Characteristics	Variability; Reliability; Capacity credit; Domestic source
•Visibility	Landscape impact turbines Nature/wildlife; birds
•Economics	Price (←→ alternatives) Related to supply charact. Impact industry, employment
•Structure energy sector	Distributed Generation; Decentralised; Small scale; Entrance new parties

Attitude object: RES project

Essential characteristics	Associated Attributes
• Location and site	Landscape identity; Annoyance; Nature/wildlife; Design; Competing spatial functions
• 'Project Owner': Initiator – Investor – Manager	Community in/outsider initiative Part of microgrid; Benefits local economy; Shareholders; Community identity; Demand;
• Wind power / solar / DG	Visibility; Clean – renewable; Supply characteristics
• Decision making process	Open / closed; Community involvement; Public/stakeholder participation; Justice/Fairness: Distributive – Recognition - Procedure

Actors designated for social acceptance (categories)
Stakeholders in development

- Incumbents in the existing energy supply sector
  - Existing power production companies
  - Power distributing companies
  - Grid managing organizations/companies
- RES developers (incl. new emerging)
- RES / SG / DG turbine industry related actors
- Actors with vested interests in domains relevant to establishing RES / DG (e.g. R&D, consultancy, engineering, construction etc.)
- Actors representing energy consumers' interests
- All actors with secondary interest in investments in RES projects (e.g. financial, labour)

Actors designated for social acceptance (categories)
Authorities and public bodies

- National government
  - Ministries in policy domains relevant to RE implementation
  - Energy market regulator(s)
  - Many Government agencies
- Regional governments
  - Spatial planning officers
  - Regional economic development officers
- Local governments
  - Spatial planning officers
  - Local economic development officers
  - Landscape - nature officers (permits)

Actors designated for social acceptance (categories)
Stakeholders in related domains

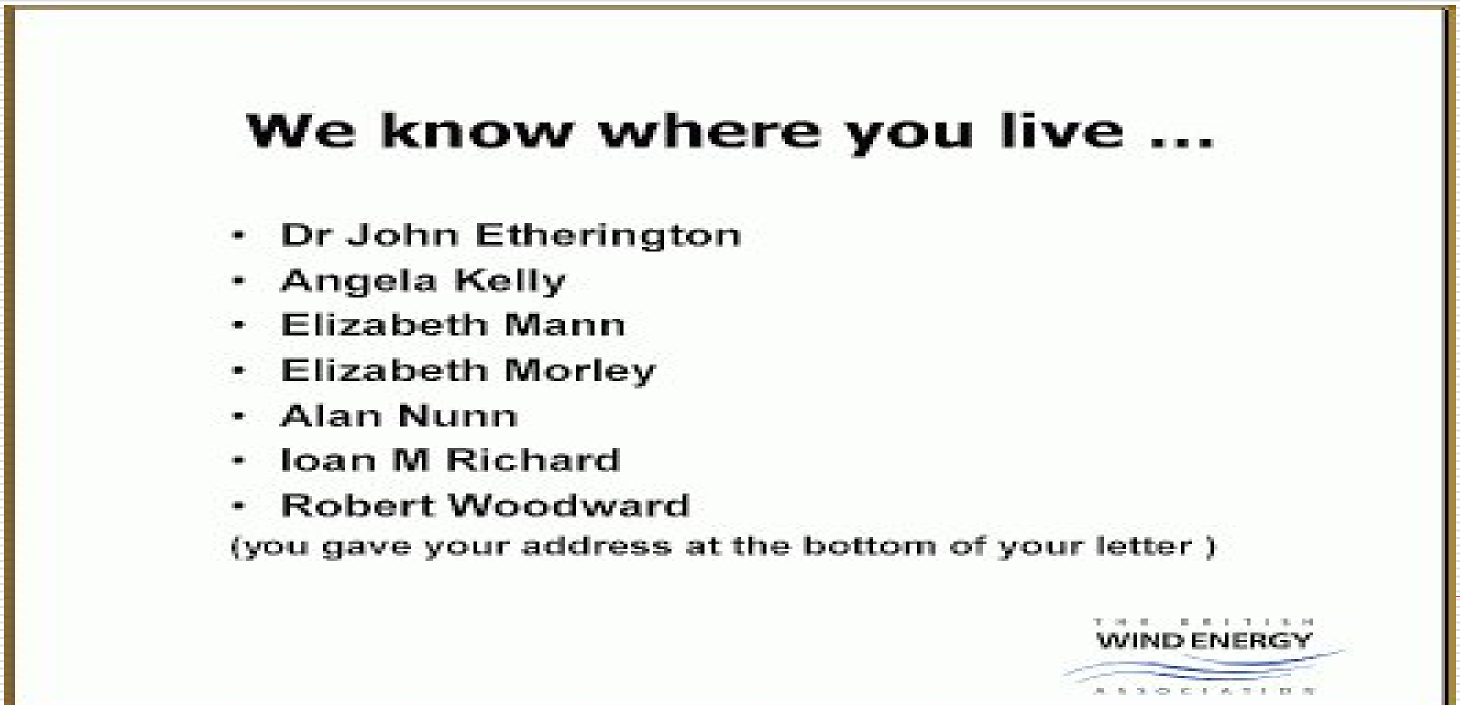
- Landscape protection organizations (ngo's)
  - national – regional - local
- Environment and nature protection organizations
- All actors with interests in competing spatial functions: - tourism – agriculture – airports – construction - fisheries – shipping – army/navy
- Actors with interests in economic sectors affected by RE
  - consultancy – agriculture – fishery – technology development - transport

Actors designated for social acceptance (categories)
public, individuals as well as organized

- General public (electorate, public opinion)
- Individuals with any perceived interest in wind developments (potential investors; co-producers)
- Communities (geographically or socially defined)
- Civil society organizations representing affected interests (members of ngo's)
- Electricity consumers
- Civil society organizations established because of wind power implementation issues
  - for private investment in wind developments
  - to counteract proposed wind developments

Framing: “Barriers to deployment” primarily local opposition (lack of community acceptance)

- A misguided assumption that policy/developers (and unfortunately also many researchers) know who is 'right' in RES conficts... and “instead we must engage with the possibility that objectors to wind power are not always 'wrong‘” Aitken M (2010)



In 2000 three important publications about institutional nature of resistance to deployment

Unruh, G.C. (2000). Understanding carbon lock-in. *Energy policy*, *28*(12), 817-830.

Elaboration systems' lock-ins preventing innovation

Jacobsson, S., Johnson, A., 2000. The diffusion of renewable energy technology: an analytical framework and key issues for research. *Energy Policy* 28, 625-640

Institutional Lock-in in RE diffusion: policies and sectors

Wolsink, M. (2000). Wind power and the NIMBY-myth: institutional capacity and the limited significance of public support. *Renewable energy*, *21*(1), 49-64.

Lack of Institutional Capacity in spatial planning system

Results from growing flow of research on social integration and acceptance of RES innovations

- Among policy makers, developers, power companies etc. huge misunderstanding of
  - what social acceptance really is
  - the essential necessity of engangement of the communities involved
- Since 2000 understanding that THE big issue in deployment of renewables is: **Institutional (in-)capacity** for utilizing the high potential acceptance of renewable energies
- Such essentials *barely socio-politically accepted* (neither by governments, nor incumbents in the electricity sector)

Renewable Energy Innovation: Institutional lock-in and institutional change

- **Institutions (def)** "patterns of behaviour of all types of actors that are reproduced and shaped by (formal as well as informal) rules and norms"
- "the organizational structure in society shaped by the rules of the game in society"

  North D, 1991. *Instit, Inst Change and Econ Perform.* Cambridge University Press.
- → Fundamental acceptance question is:

  *What **institutional changes** are required to implement and integrate renewables' innovation in the STS of power supply and demand?*
- Or: The acceptance to changes in "the organizational structure" in power supply, to escape the institutional lock-in

Institutional lock-in: existing patterns of thinking and behaviour

"Alternatives representing radical technological change have to come from outside organisations representing the existing technologies, whereas the existing incumbents even make efforts to eliminate alternatives from decision-making processes."

Lund H (2010) *The implementation of renewable energy systems. Lessons learned from the Danish case*. Energy 35: 4003-4009.

Comparison of 12 decision-making processes in RES projects in 1st country successful in RES implementation

Sources of institutional lock-in

Unruh, 2002. Escaping carbon lock-in. *Energy Pol* 30, 317–325

- Technological: Dominant design, standard technological architectures and components, compatibility
- Organizational Routines: training, customer-supplier relations, centralized energysystems
- Industrial Industry standards: technological inter-relatedness, co-specialized assets
- Societal System: socialization, adaptation of preferences and expectations
- Institutional Government: policy intervention, legal frameworks, departments/ministries, hierarchical tendencies

PV/wind socio-political acceptance: institutional constraints mainly at this level

- Financial procurement systems essential; for solar power and development of consumer owned units even more than for wind power
- Feed-in tariff (REFIT) systems support new local investments, new suppliers, new innovating actors
- Willingness to force e-companies to accept grid connection with stable accountable remuneration is questionable in many countries
- Willingness to change market regulations and energy-legislation to help the emergence of micro-grids and smart grids is questionable
- New character of siting decision also requires new institutional conditions (fit to local community)

Energy Supply system fully based on Renewable sources

- Spatial claims renewables "huge"
  MacKay DJC 2008. Sustainable Energy – without the hot air. UIT Cambridge. www.withouthotair.com (open access)
- Storage infrastructure
- All space that can be made acceptable should be used
- Variable sources
- Limiting transmission by
  - Integration supply and demand
  - Power grid applied as 'storage' capacity

Charles D 2009 Science 324: 172-175 "Renewables test IQ of the grid"

Individual feasibility renewable facilities requires optimization of different supplies and demands

- Combined sources: different patterns of intermittancy
- Combined optimization supply and demand: needs (micro-)optimization
- Development of (local) micro-grids,
  - of several users in a 'community'
  - including load-control
  - including local storage (electr. vehicles)
- Smart meters (really smart, not the current control meters) including smart regulation
- Requires "Smart Grid"

Strong pressure on the power grid: towards a "Smart Grid"

- "Power grid consisting of a network of integrated micro-grids that can monitor and heal itself" *Marris E (2008) Upgrading the grid. Nature 454: 570-573*
- Micro-grids: local groups of different consumers and distributed generators
- → Fundamental question:
  *Which **institutional changes** needed to deploy smart micro-grids with renewable distributed generation as much as possible?*
- Who will invest? Who has control about what? Does micro-generation get priority over large-scale unsustainable generating capacity?

Distributed Generation

Ackermann, Andersson, Söder 2004

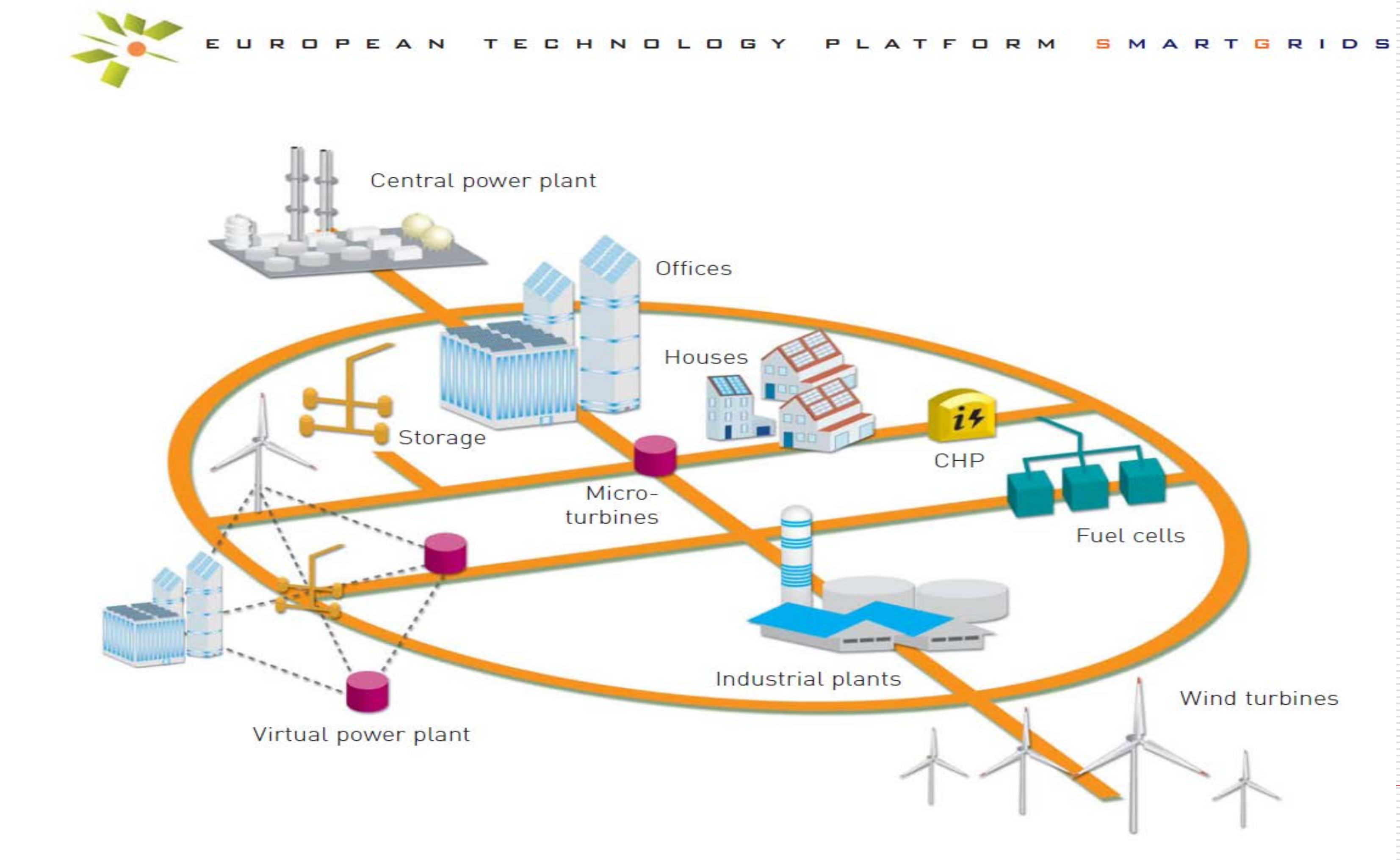
- Combined cycle gas T. 35–400 MW
- Internal combustion engines 5 kW–10 MW
- Combustion turbine 1–250 MW
- Micro-Turbines 35 kW–1 MW
- *Renewable*
- Small hydro 1–100 MW
- Micro hydro 25 kW–1 MW
- Wind turbine 200 Watt–3 MW
- Photovoltaic arrays 20 Watt–100 kW
- Solar thermal, central receiver 1–10 MW
- Solar thermal, Lutz system 10–80 MW
- Biomass, e.g. gasifiacation 100 kW–20 MW
- Fuel cells, phosacid 200 kW–2 MW
- Fuel cells, molten carbonate 250 kW–2 MW
- Fuel cells, proton exchange 1 kW–250 kW
- Fuel cells, solid oxide 250 kW–5 MW
- Geothermal 5–100 MW
- Ocean energy 100 kW–1 MW
- Stirling engine 2–10 kW
- Battery storage 500 kW–5 MW

Renewable Energy:
"Distributed generation"

- Micro/decentralized generation:
  Small scale, spatially dispersed
- **Definition :** Distributed generation is an electric power source connected directly *to the distribution network* or on *the customer site of the meter*.
  Ackermann, Andersson, Söder 2004

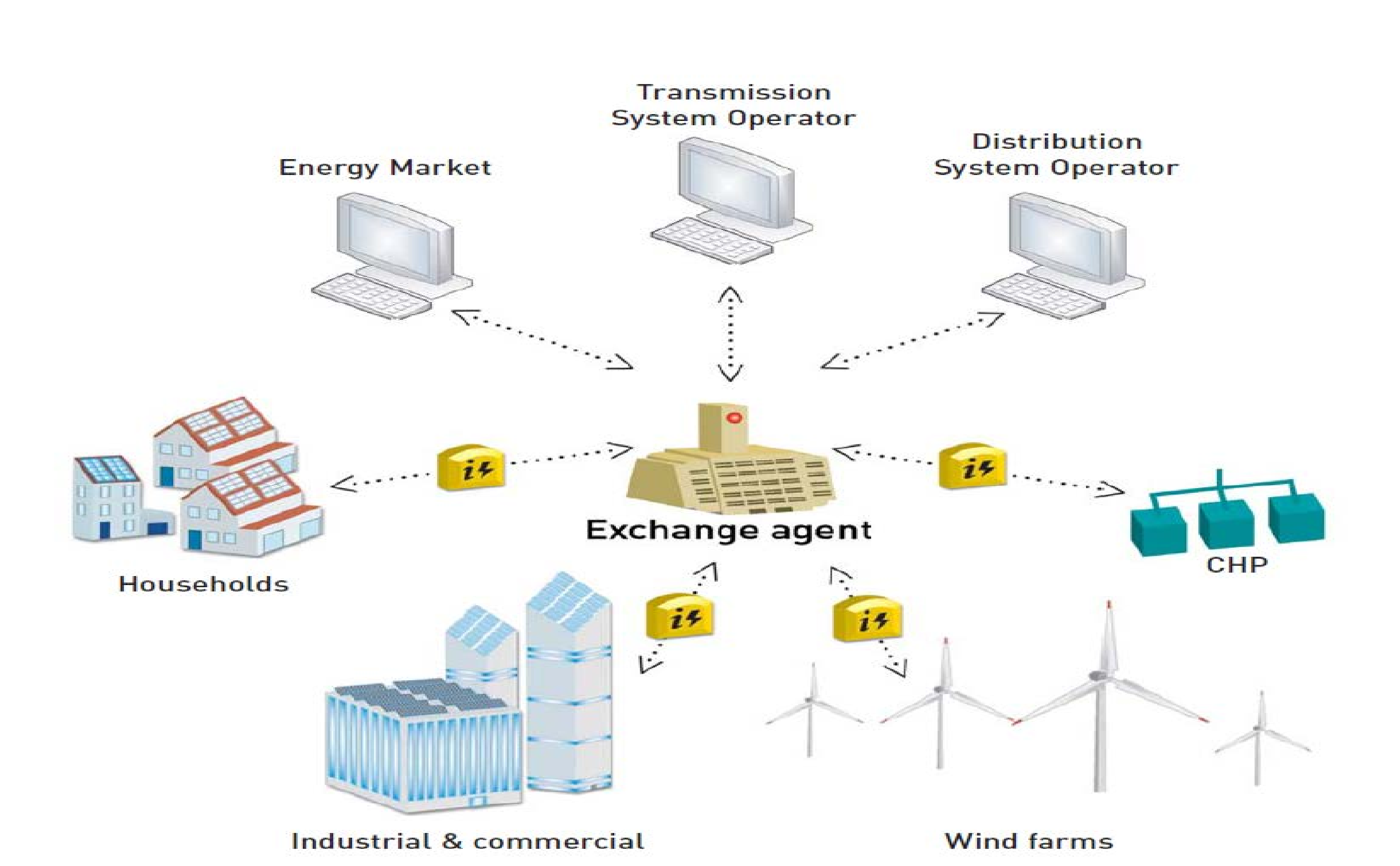
Centralized, large scale; high infrastructure cost; continued of dependance (example Desertec)

EU vision on 'smart grids'



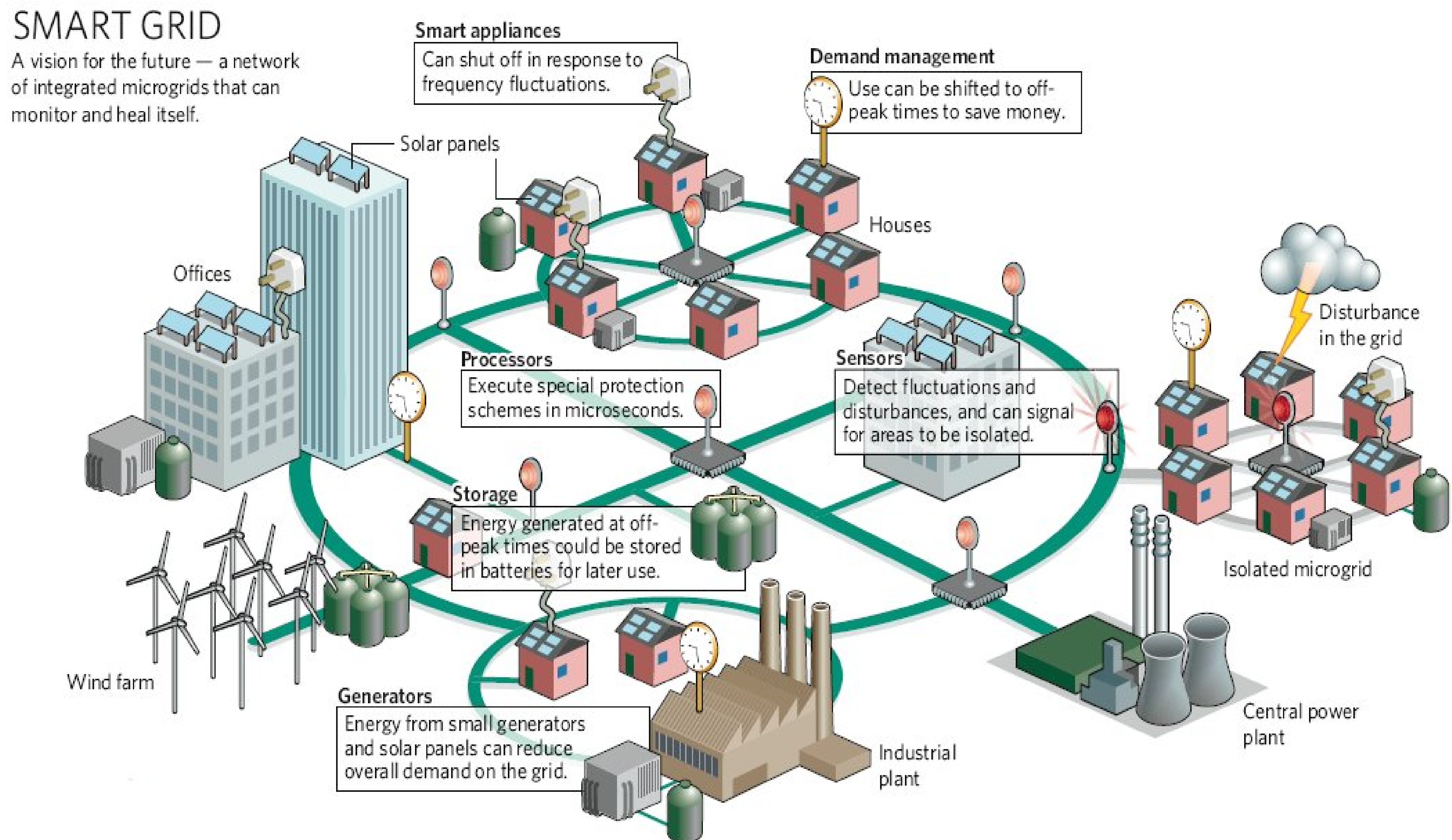
Vision EU on ‘smart grids’

EU vision ‘smart grid’ Framing: current “path dependant” power supply systems; still *centralized control*



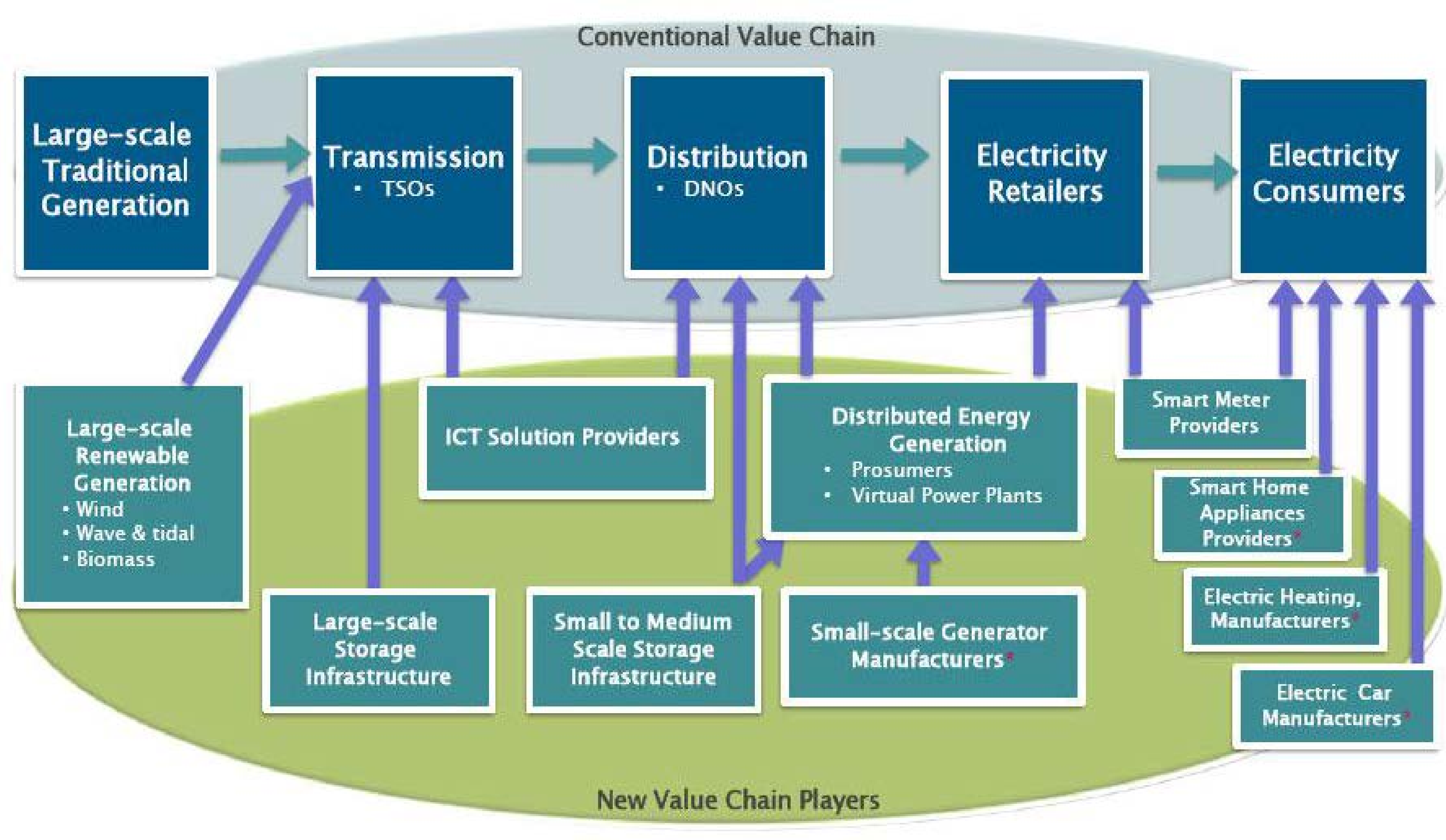
'Smart grid': "...rescaling and distributed generation" ... "integrated micro-grids that can monitor and heal itself"

Marris 2008, *Nature* 454, 570



Institutional Changes: New players; New roles; Disappearing players?

Xenias et al 2014

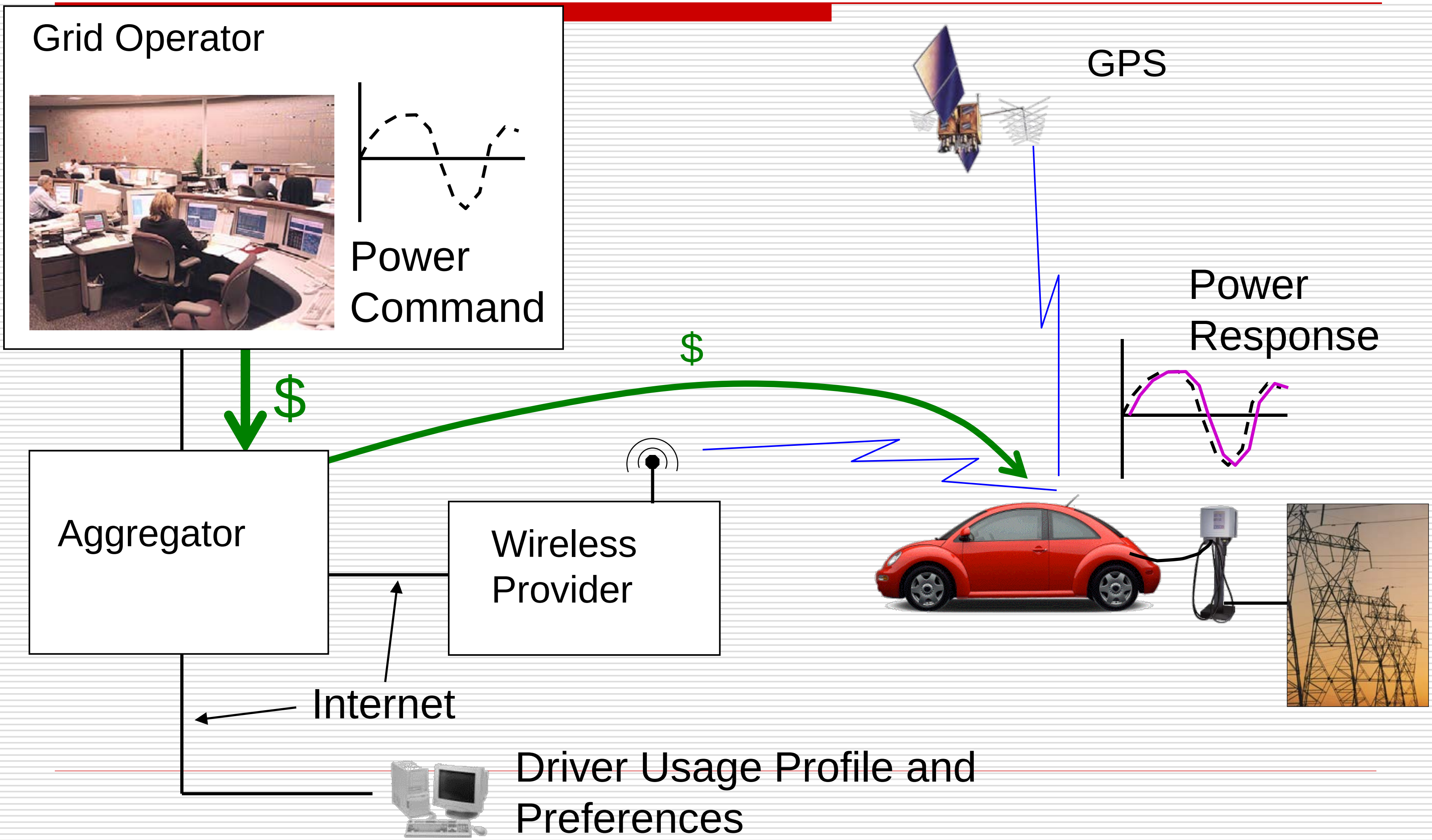


Example V2G integration

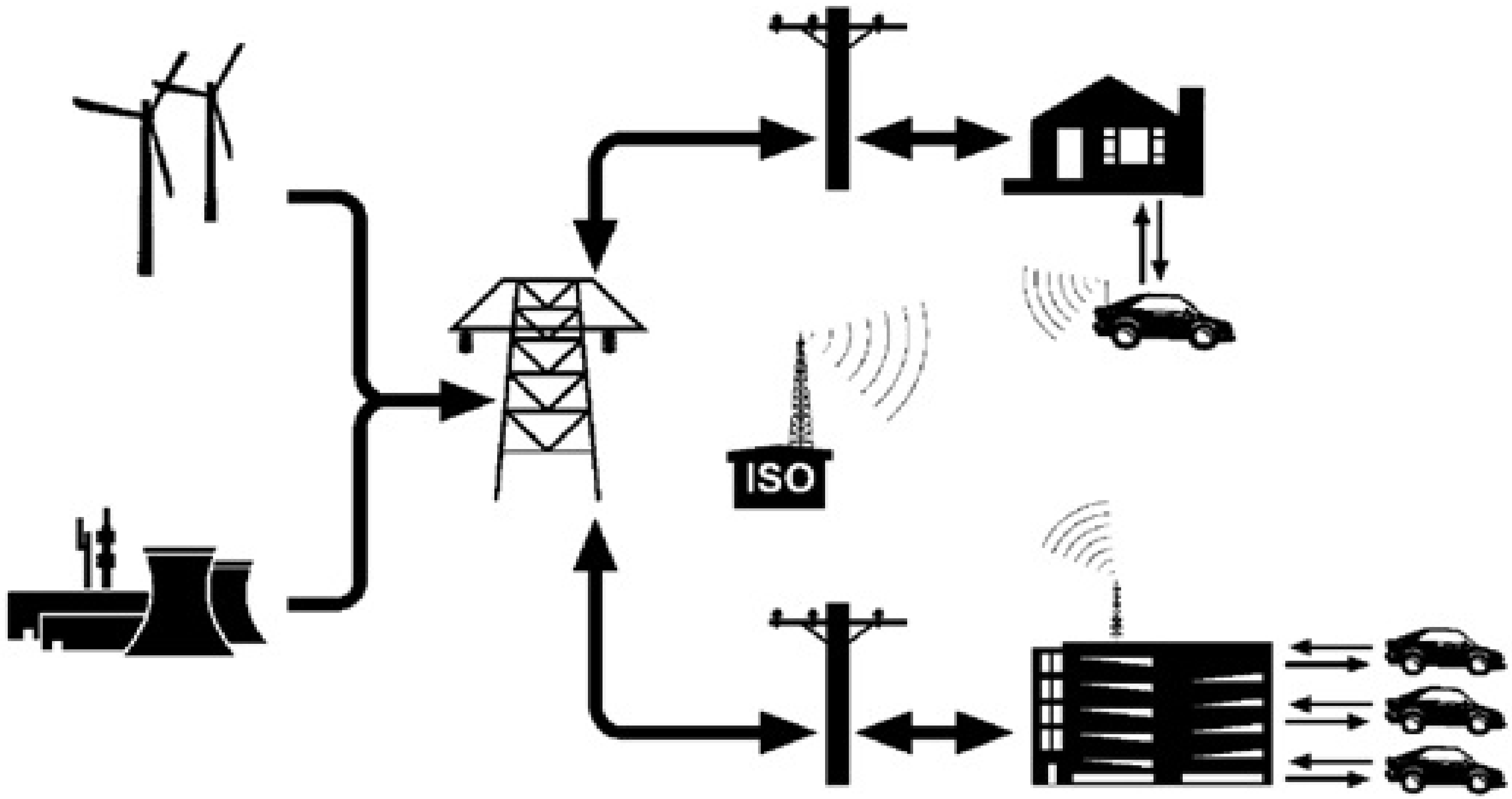
- controlled Electric Vehicles charging and cross-border transmission capacity
- reduce electricity dispatch costs,
- curtailment of variability renewable energy sources (RES)
- curtailment storing energy by utilizing pumped hydro
- absorbing unserved load.

Verzijlbergh et al, 2014

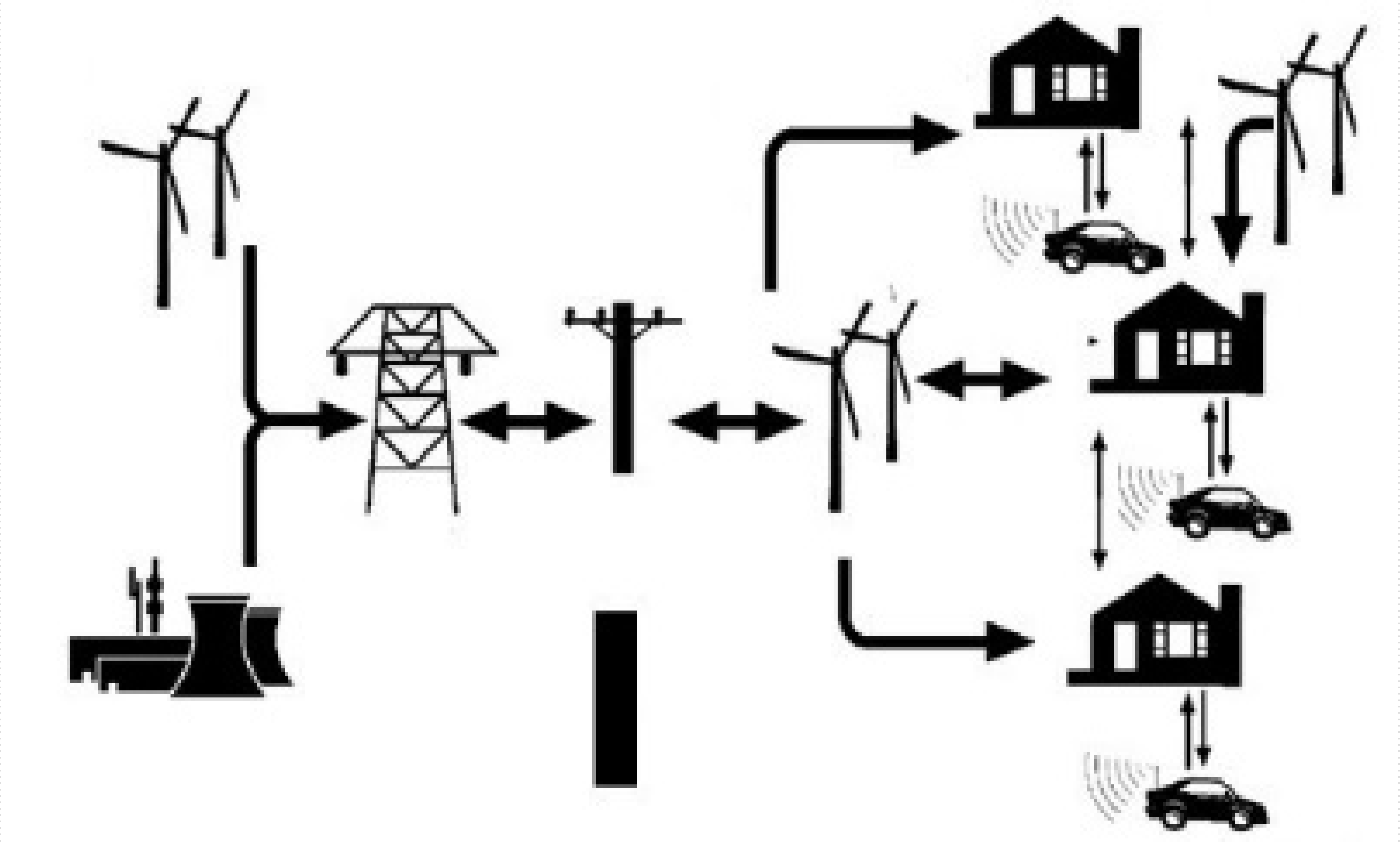
Grid Regulation with an EV



V2G Centralized vision



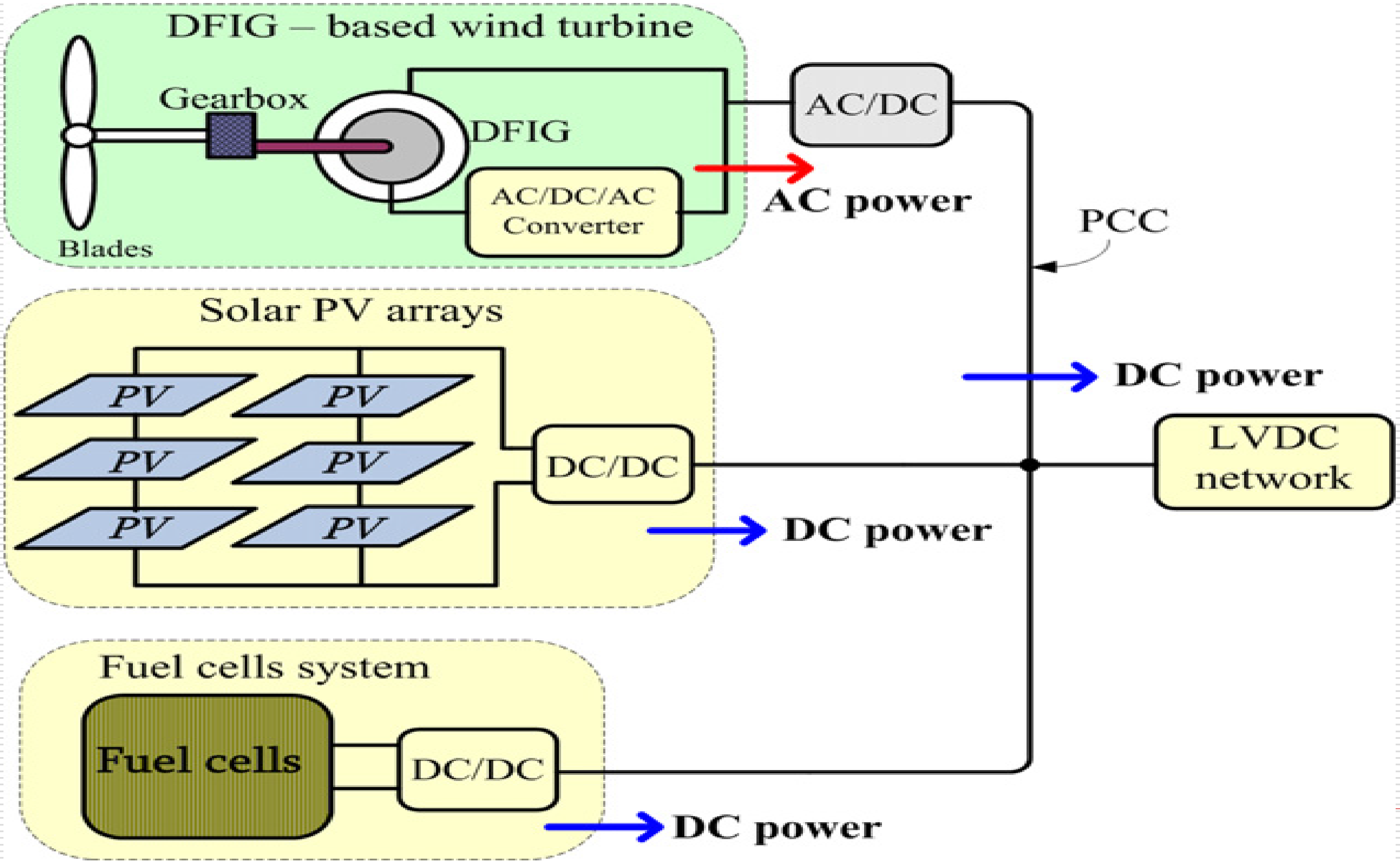
V2G: *Prosumer vision:* storage V2G helps RE integration in microgrid; enhancing acceptance and limiting transmission



Example: DG units with LowVoltage DC network

[Justo et al. 2013, 390]

Unruh (2000) shows AC/HV is part of the STS lock-in



Distributed generation in smart grid

- Many embedded innovations
- Different innovations all require institutional change
- Integrated deployment of numerous small scale dispersed located generating units
- Huge geographical variety
- Rural/remote areas: more space (=potential generating capacity) available, less proximity supply and demand
- Urban: high proximity; less space; conflicting claims/ competions for space

SG and DG Market acceptance: who will be in charge?

- Concept of *'distributed generation':*
  technical definitions only focus upon geographically dispersed units of power generation
- Essential in the definition is the *ownership / control*
  – of the generating units
  – of the smart meter (including its regulation)
  – the micro-grid
- In most countries these still are E-companies (with its generating units 'distributed',
- Or do the consumers own the units on their rooftops, can use their own smart meter, and exchange their generated power?

Renewable Energy is a *natural resource* Common Pool Resource(CPR)

Ostrom E

- Governance of Common Pools is a question of institutions
- Socio-ecological systems are complex and highly variable
- Governing SES's must be adaptice, diverse, polycentric
- Multi-layered instead of hierachical and centralized
- Also applies for man-made common pools, like Socio-Technical Systems

Ostrom, 1999.

"Contemporary policy analysis of the governance of common-pool resources is based on three core assumptions:

(*a*) resource users are norm-free maximizers of immediate gains, ……

(*b*) designing rules to change incentives of participants is a relatively simple analytical task

(*c*) organization itself requires central direction"

"……… all three assumptions are a poor foundation for policy analysis."

Ostrom E, 1999. *Coping with tragedies of the commons.* Ann Rev Polit Sci 2, 493

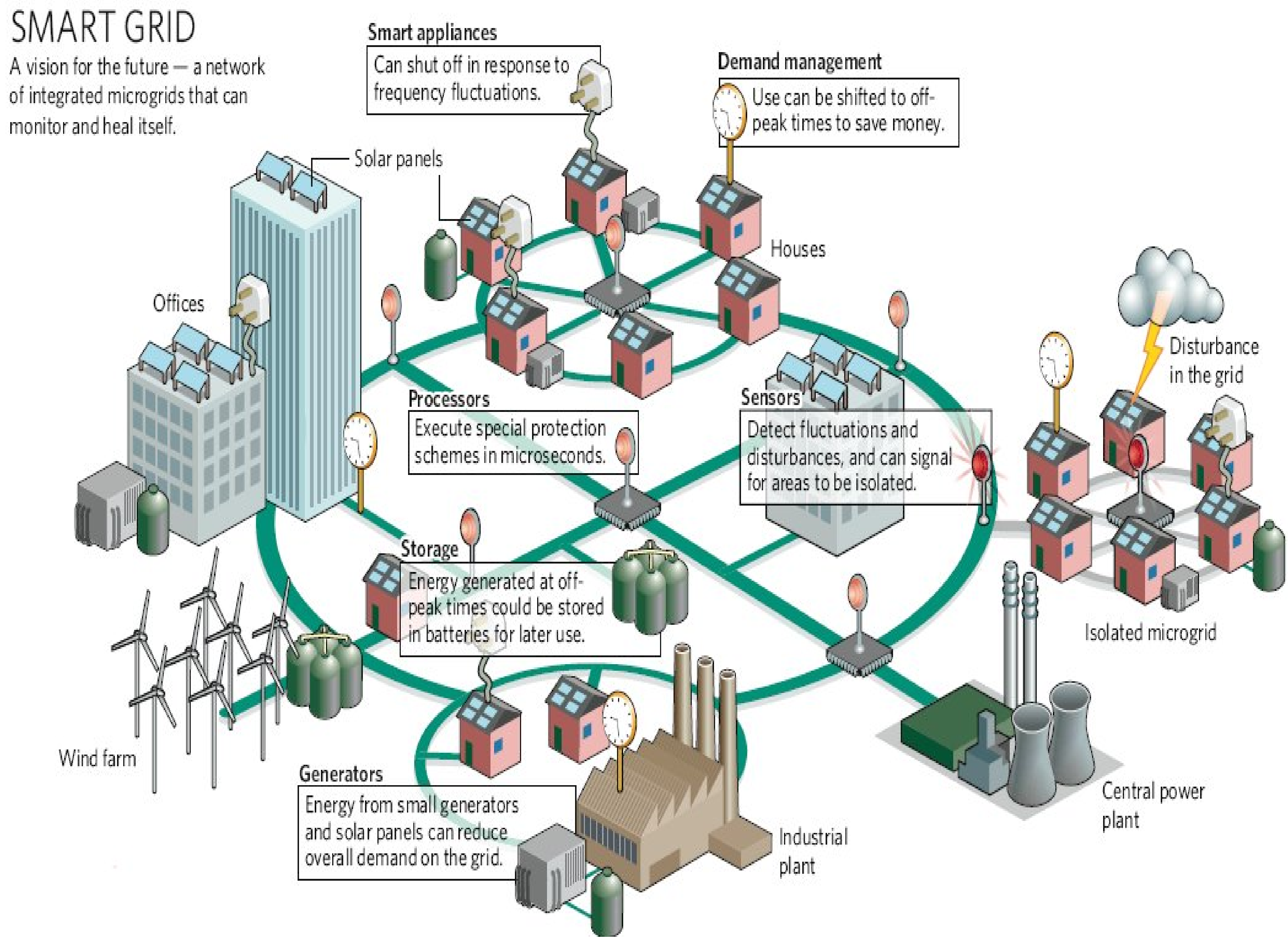
CPR management must be based on institutional analysis

- Government rules and privatization → negative result on the degradation of natural resources
- *Co-production* of the common good essential element of a good governance regime
- Other *institutions* must be fostered/created allowing and favouring (self-)governance and adaptive governance protecting CPR's
- Hierarchy and central direction discourages co-production
- Property, control and access are key determinants for acceptance

Power supply: Socio-Technical System

- Access to resource is free
- But acces to space needed for generation is limited, *and* due to property regimes
- Energy leads to redefinition of concept of Space
- Boundaries more complex: resource rights

  Vermeylen 2010


SMART GRID
A vision for the future — a network of integrated microgrids that can monitor and heal itself.
Smart appliances
Can shut off in response to frequency fluctuations.
Demand management
Use can be shifted to off-peak times to save money.
Solar panels
Houses
Offices
Disturbance in the grid
Processors
Execute special protection schemes in microseconds.
Sensors
Detect fluctuations and disturbances, and can signal for areas to be isolated.
Storage
Energy generated at off-peak times could be stored in batteries for later use.
Isolated microgrid
Wind farm
Generators
Energy from small generators and solar panels can reduce overall demand on the grid.
Industrial plant
Central power plant

Space formerly defined as physical ‘place’ Competing claims → space ‘socially constructed’

- Resource right make claims more complex
- Different actors/stakeholders
  → Different “notions of space”; hardly recognized

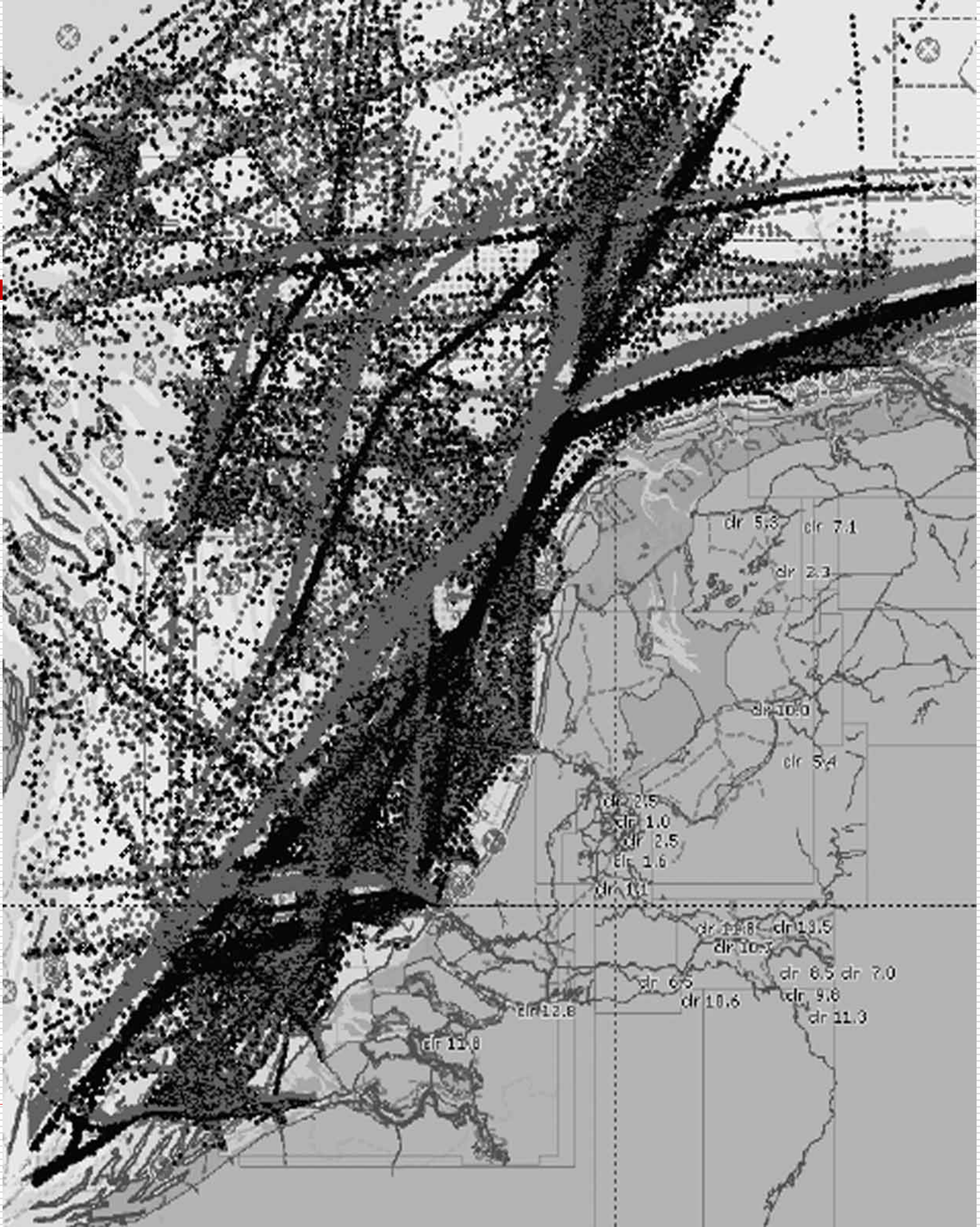
- Example: states tend for planning by tendering WP locations
- E-companies and other large investers tender
- Without substantial knowledge from the socially contructed notion of space at sea
- e.g shipping: ‘space’ based on heavy slowly moving objects
- “Rijkswaterstaat* had no adequate nautical knowledge”
  Jay 2012,p.93
- →No collaborative planning → failure

* government agency Ministry of Transport, Water Management and Infrastructure

South part continental shelf zone Netherlands

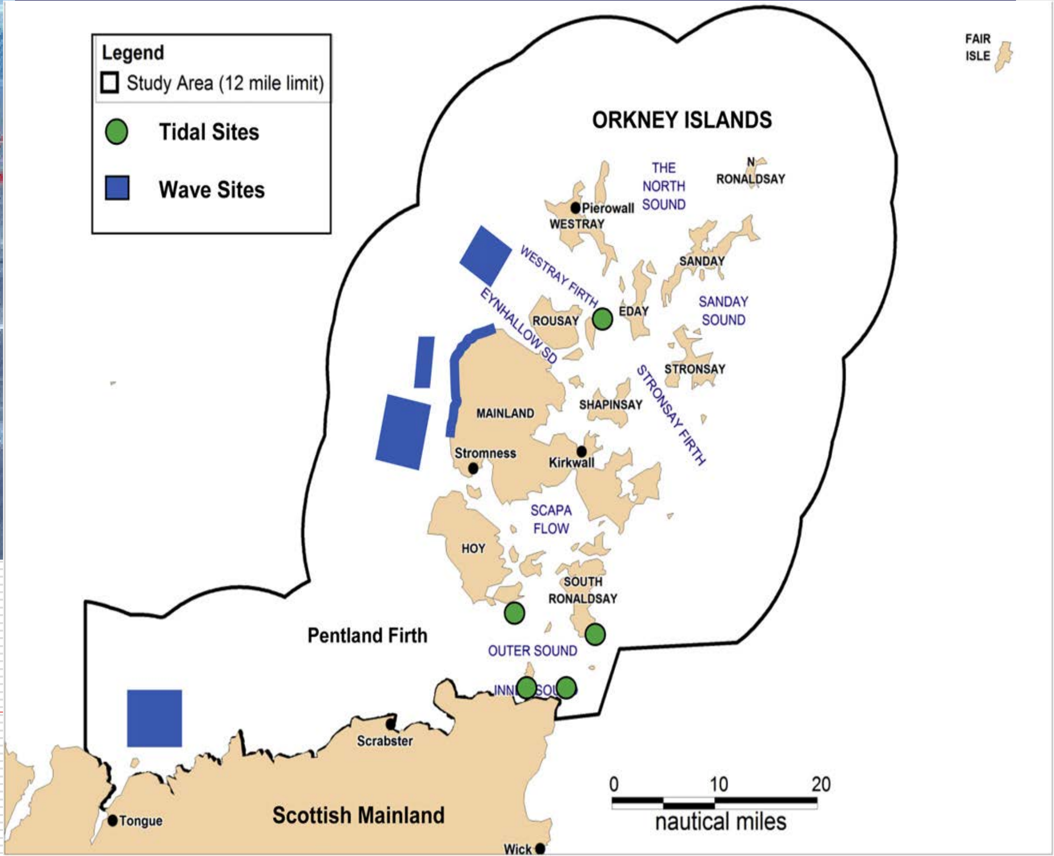
AIS shipping data

Location for off-shore wind farms planned and tendered without collaboration and input from shipping agencies, e.g. port of Rotterdam



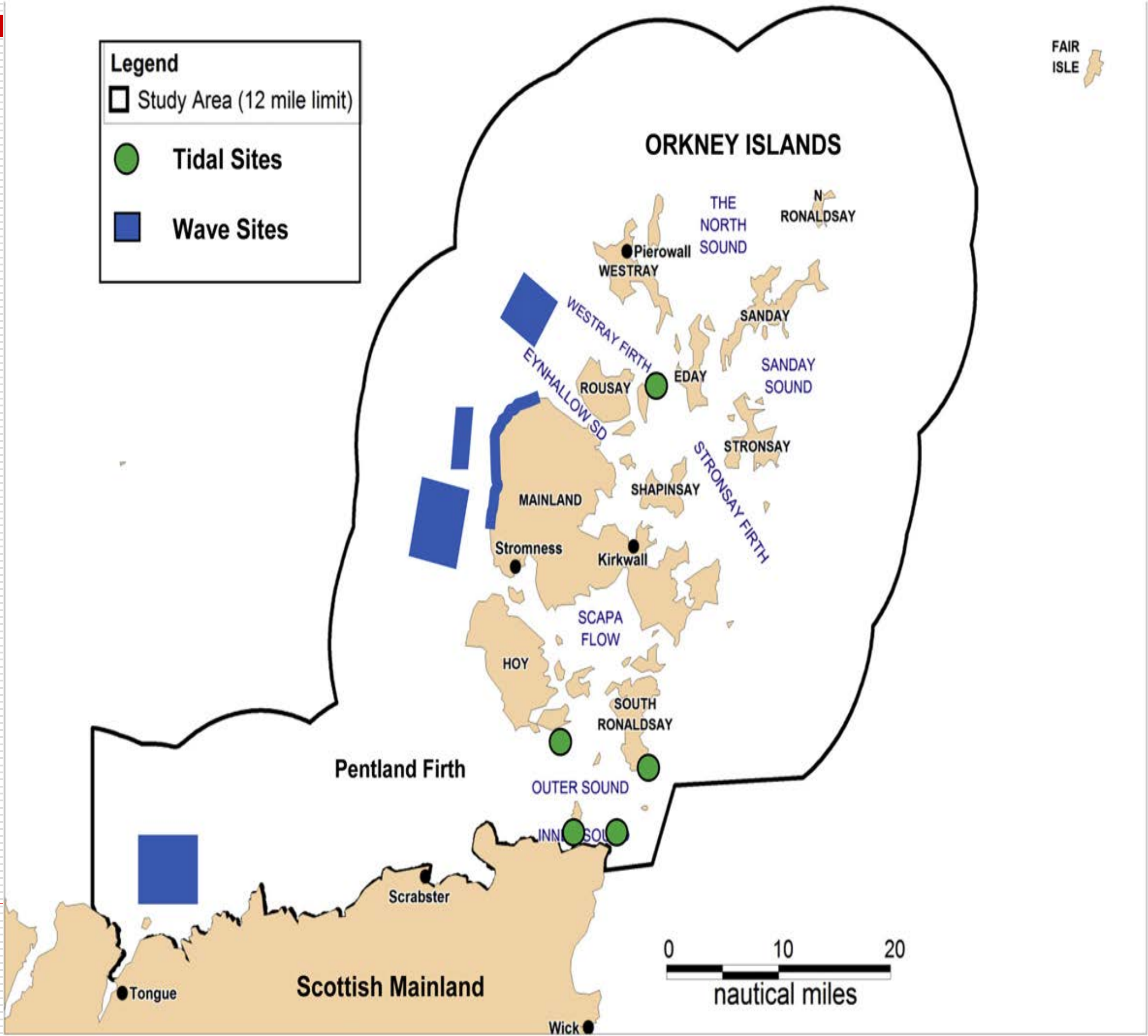
Jay 2012 *JEnvPolPlan* 14, p.91

Marine energy
Tidal and Waves



Example: wave and tidal power Orkney's North Scotland Johnson et al 2012 Ocean Coast Man 65, 28

"In island and peripheral areas the inshore fishery is of heightened socio-economic importance ……. where job options are few. It is relatively open access with few legislative controls. *Informal and cooperative management is Common".*



So, informal self-governance was the CPR management regime; while E-companies and state governments institutionally think in term of centralization and hierarchy

“The Government in Scotland has adopted a central ‘top-down’ approach to the planning and licensing of marine renewables although they have been pre-empted in the planning of these first projects by the actions of the Crown Estate. There are requirements for consultation and participation in decision making but few powers have been delegated to local authorities. Some local powers have been curtailed under the provisions of legislation such as the Electricity Act 1989 and the Energy Act 2004.”

Johnson et al 2012 Ocean Coast Man 65, 32

Literature

Ackermann et al.(2001) Distributed generation: a definition. *Electric Power Systems Research* 57, 195–204

Aitken, M. (2010) Why we still don't understand the social aspects of wind power. *Energy Policy* 38: 834-841

Ajzen, I. (1991) The theory of Planned Behaviour. *Organ Behav Hum Dec* 50 p.182

Alanne K, Saari A (2006) Distributed energy generation and sustainable development. *Renewable and Sustainable Energy Reviews* 10, 539–558

Charles D (2009) Renewables test IQ of the grid. *Science* 324: 172-175

Halsnæs K et al. (2012). Mitigation and Adaptation Strategies for Global Change. Climate change mitigation policy paradigms—national objectives and alignments, Mitigation and Adaptation Strategies for Global Change. IPCC.

IPCC (2012) *Renewable Energy Sources and Climate Change Mitigation.* Cambridge University Press.

IPCC (2014) *AR5*.

Jacobsson S, Johnson A (2000) The diffusion of renewable energy technology: an analytical framework and key issues for research. *Energy Policy* 28, 625-640

Jay S. (2012) Marine Space: Manoeuvring Towards a Relational Understanding. *Journal of Environmental Policy and Planning* 14, 81-96

Johnson K, Kerr S, Side J. (2012) Accommodating wave and tidal energy - Control and decision in Scotland. *Ocean & Coastal Management* 65, 26-33

Justo JJ, Mwasilu F, Lee J, Jin-Woo Jung J-W (2013) AC-microgrids versus DC-microgrids with distributed energy resources: A review. *Renew Sust Energ Reviews* 24, 387–405

Lund H (2010) The implementation of renewable energy systems. Lessons learned from the Danish case. Energy 35: 4003-4009.

Marris E (2008) Upgrading the grid. *Nature* 454: 570-573

MacKay DJC (2008) *Sustainable Energy – without the hot air.* UIT Cambridge.

North D (1990) *Institutions, Institutional Change and Economic Performance.* Cambridge University Press, Cambridge

Ostrom E (1999) Coping with tragedies of the commons. *Annual Review of Political Science* 2, 493- 53

Sovacool B (2009) Rejecting renewables: The socio-technical impediments to renewable electricity in the United States. *Energy Policy*, *37*(11), 4500-4513.

Toke D, Breukers S, Wolsink M (2008) Wind power deployment outcomes: How can we account for the differences? *Renewable and Sustainable Energy Reviews* 12, 1129-1147

Unruh GC (2002) Escaping carbon lock-in. *Energy Policy* 30, 317–325.

Vermeylen S. Resource rights and the evolution of renewable energy technologies. *Renewable Energy* 2010;35:2399–405.

Verzijlbergh, R., Martinez-Anido, C. et al. 2014. Does controlled electric vehicle charging substitute cross-border transmission capacity? *Applied Energy* 120, 169-18

Walker G, Devine-Wright P. (2008) Community renewable energy: What should it mean? *Energy Policy* 36, 497-50

Wolsink, M. (1990) *Maatschappelijke acceptatie van windenergie: houdingen en oordelen van de bevolking.* Thesis Publishers, Amsterdam.

Wolsink M, (2000) Wind power and the NIMBY-myth: institutional capacity and the limited significance of public support. *Renewable Energy* 21, 49-64

Wolsink, M. (2012) The research agenda on social acceptance of distributed generation in smart grids: Renewable as common pool resources. *Renewable and Sustainable Energy Reviews* 16, 822–835.

Wolsink M (2013). Wind Power : Basic Challenge Concerning Social Acceptance. In: L.Y. Kaltschmitt, M., N.J. Themelis, L.Y. Bronicki, L. Söder & L.A. Vega (Eds.), *Renewable Energy Systems* (pp. 1785-1821). New York: Springer.

Wolsink M (2013) The next phase in social acceptance of renewable innovation. *EDI Quarterly, 5*(1), 10-13.

Wüstenhagen R, Wolsink M, Bürer MJ (Eds) (2007) Social acceptance of renewable energy innovation. *Energy Policy* 35, 2683-2889