ICT Strategies for The Supergrid

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03 May 2011

Introduction

The emerging €6.4 Trillion Offshore Wind Energy Market, enabled by The Supergrid, is the key to Europe's Energy Future

Mainstream is the largest independent Offshore Wind Energy Developer in the world

To accelerate the Supergrid, Innovative ICT solutions, new ICT policies, new ICT standards and greater cooperation across the ICT supply chain are needed

ICT Strategies for The Supergrid

- Mainstream Renewable Power
- Offshore Wind in Europe
- Supergrid Enablers
- Offshore Wind Developers' ICT needs
- EU Data Management initiatives
- Mainstream's Current ICT Strategy
- The need for ISIS: "Integrated Sea Information System"
- Next Steps

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Vision

Mainstream Renewable Power was founded by Dr. Eddie O'Connor in February 2008.

" Our vision
is of thriving economies and communities
liberated from the restrictions of fossil fuels,
using
renewable energy
as their
mainstream source of power. "

The world is experiencing a **once-off historical transition** to sustainable fuels: Each one of our 195 countries must go through it.

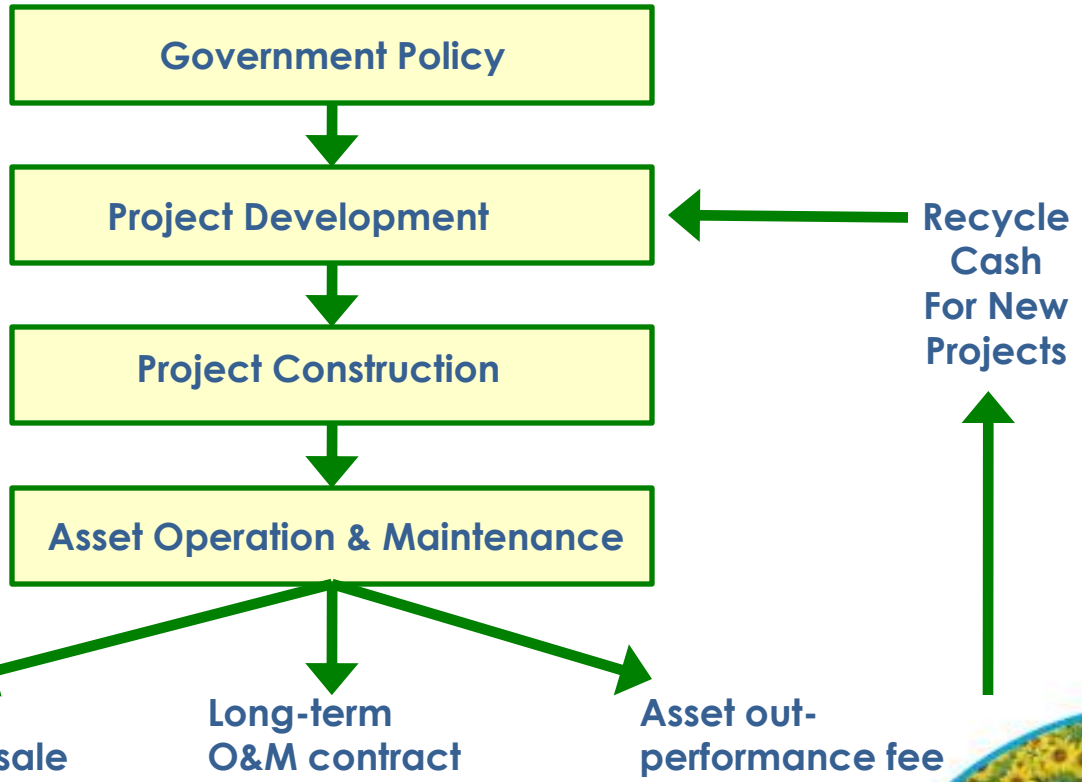
4 fundamental issues drive this transition ;

- **Climate change**
- **Ever-increasing Demand for Energy**
- **Rising Fossil Fuel Prices**
- **Energy Security**

This Vision demands a strong Business Model

Mainstream's Business Model

- **Sustainability as a business** is what we do at Mainstream : wind & solar.
- **Mainstream's business model spans 4 key areas ;**



A sustainable pipeline of Renewable Energy projects secured

Mainstream's 14,000+ MW Projects' Pipeline

8 offices, 4 continents, growing fast

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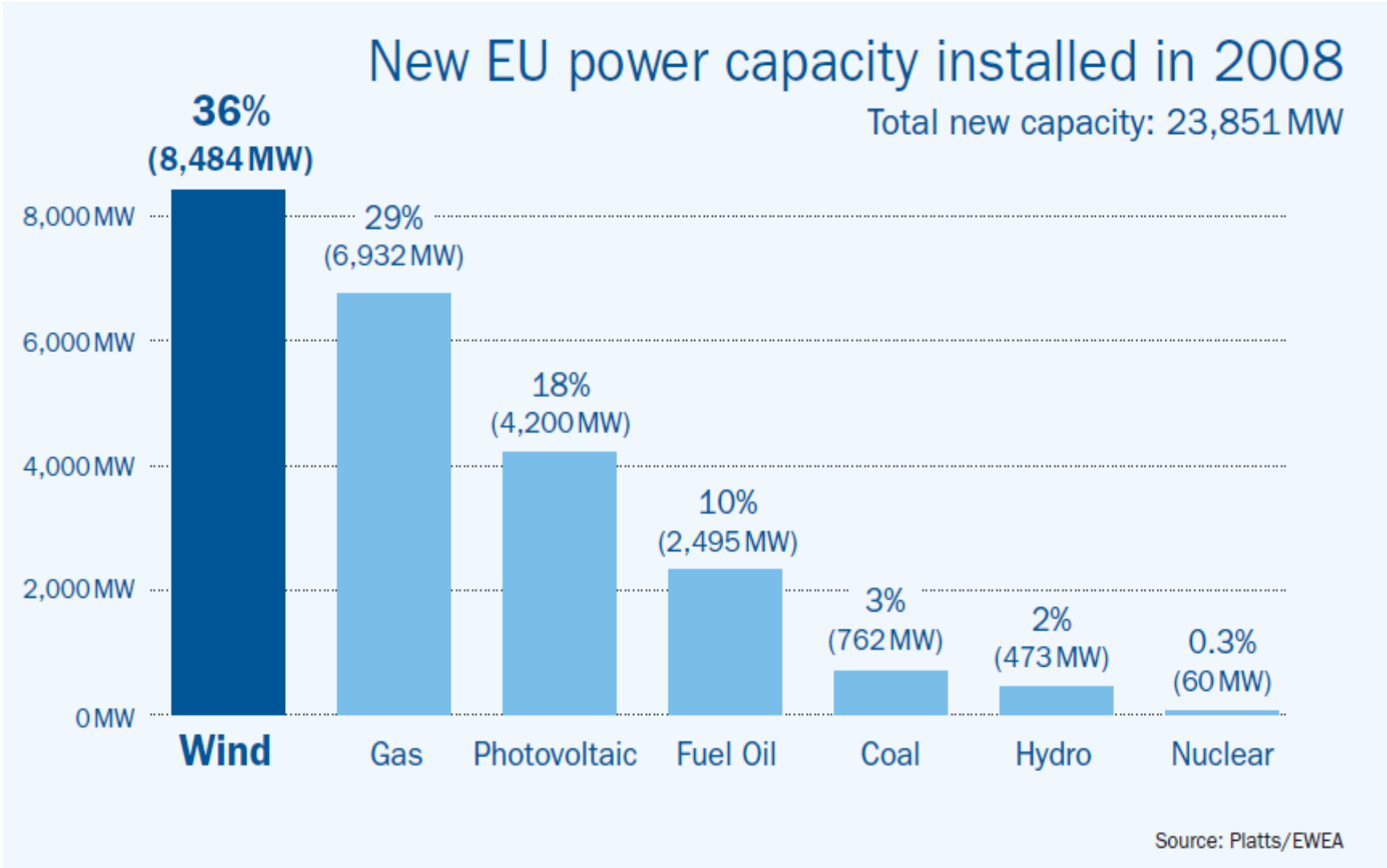
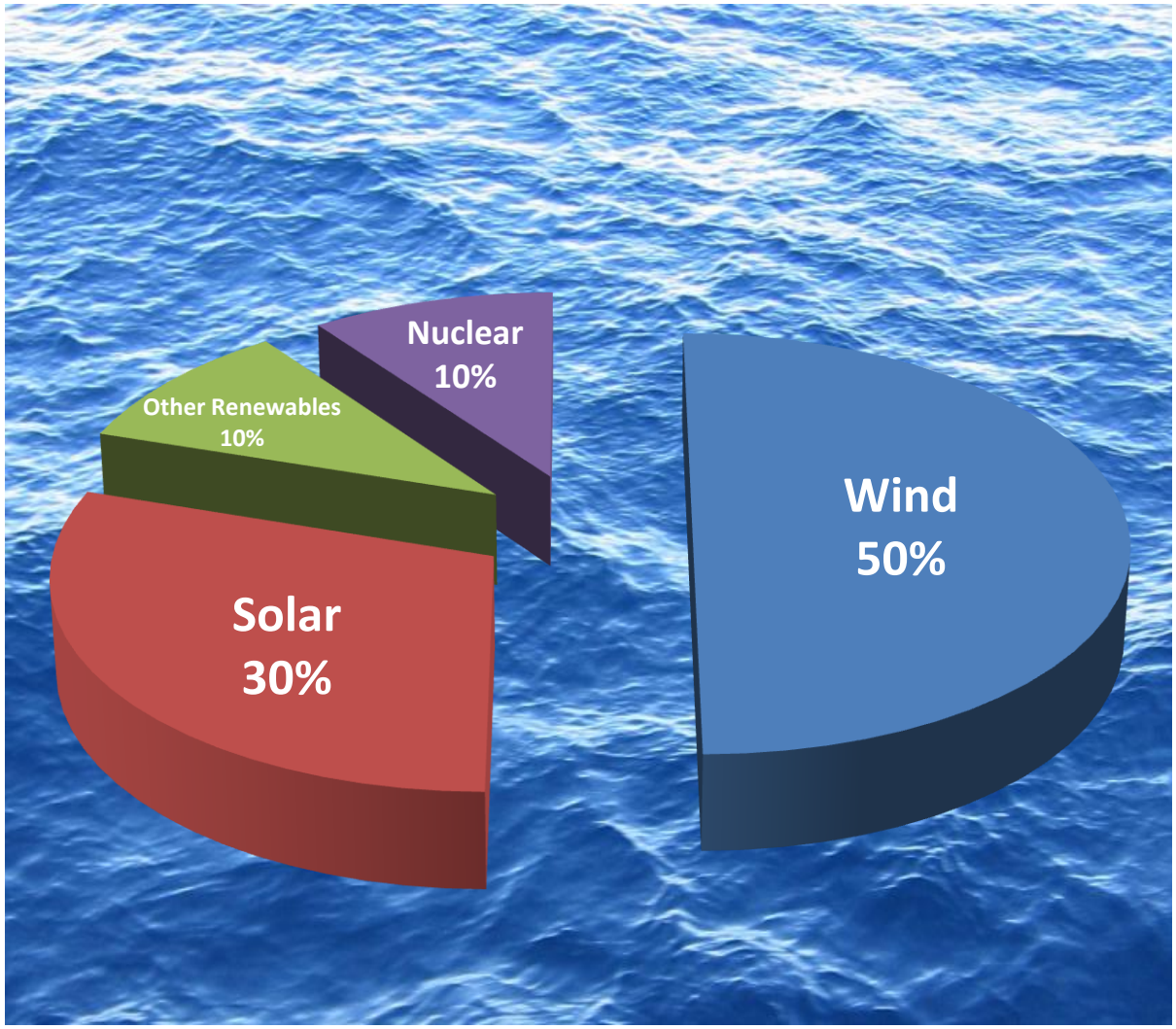
EU Energy Perspective : Current Investment Mix



> 50 % of new Generation Capacity from Wind & PV

EU Energy Perspective : 2050 Mix



Energy Demand

Offshore Winds farms are needed for Europe to meet Green House Gas Targets

Interconnection across EU member states is needed to enable Offshore Wind

Interconnection, or Supergrid is vital for delivery of any 2050 scenario

2020 offshore grid connections must be Supergrid-compliant

> 80 % of Generation Capacity will be from Wind & PV

EU Energy Perspective : Where is the Wind Resource?

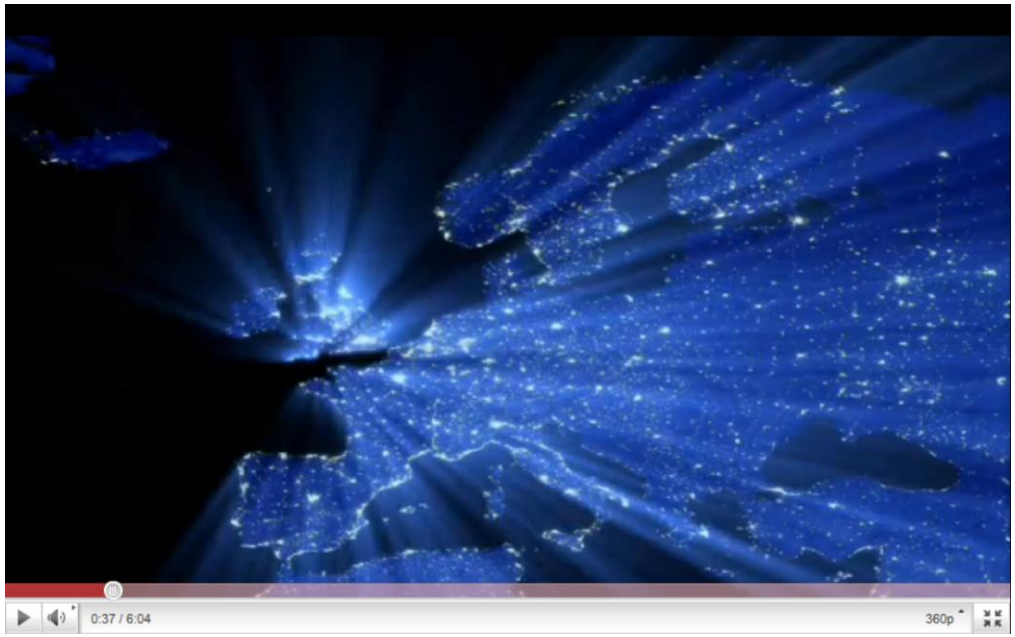
- **1,800,000 MW** of installed Wind Power needed by 2050
  - Based on projected 2050 energy requirements
- **200,000 MW** from Onshore Wind : the limit
  - The limit because Europe is the world's most crowded Continent
- **1,600,000 MW** from Offshore Wind
  - Plenty of space to grow beyond this target
  - Achievable at €3,600,000.00 per MW installed

Equates to :

- **€5.8 Trillion** investment in Offshore Wind Turbines by 2050.
- **€0.6 Trillion** investment in associated Offshore transmission and distribution .

European Offshore Wind is a €6.4 Trillion Investment opportunity

Video : 2050 Challenge



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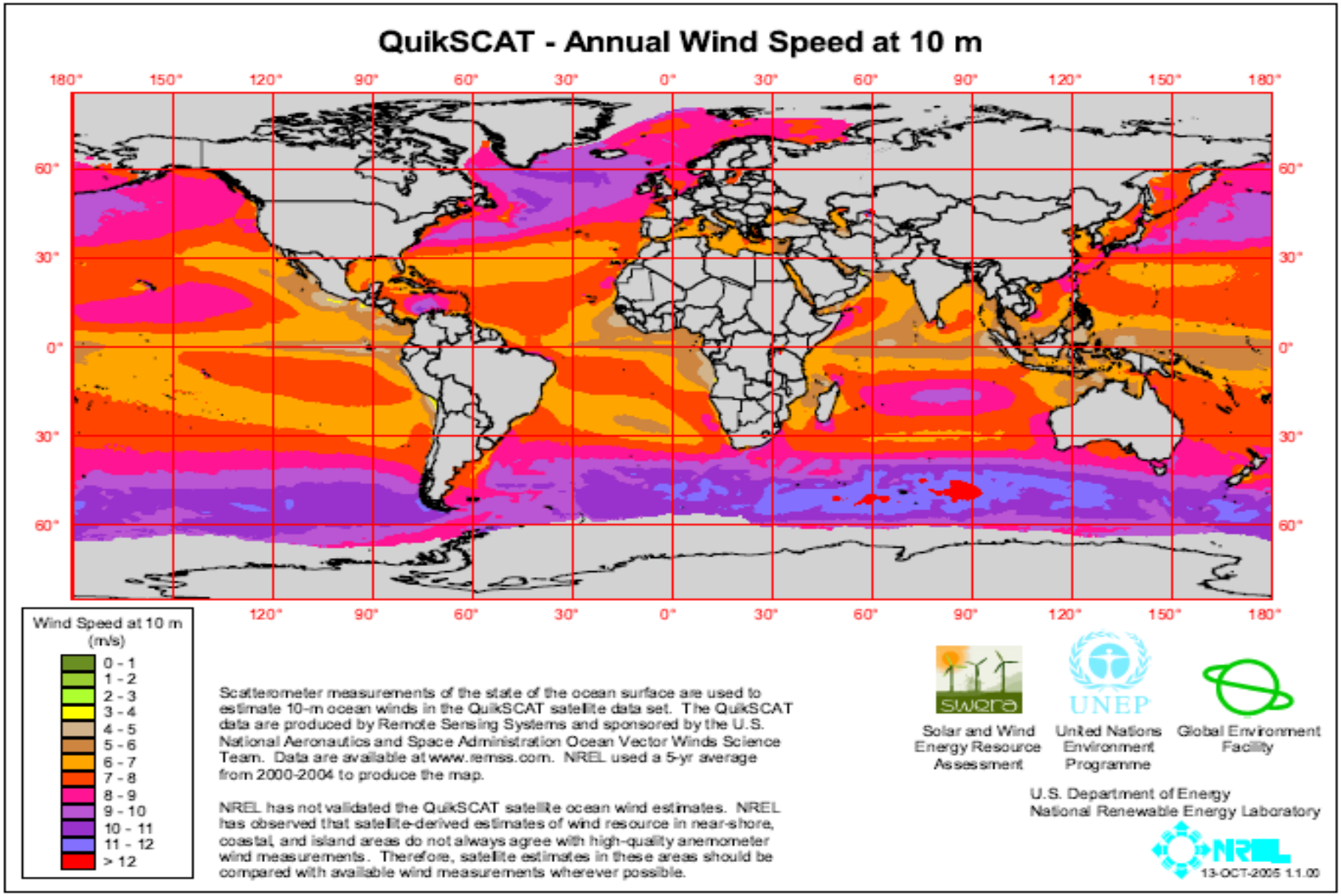
MAINSTREAM RENEWABLE POWER

Offshore Wind Resource



Offshore Wind in the North Sea represents Europe's best option

Europe's Electricity Demand

Europe's Power Demand

EU27 Demand (2008): **3,200 TWh**

Offshore Wind Power Available

Area considered with 5MW/Km^2

North Sea:	**35,700,000 MW**
Mediterranean Sea:	**12,500,000 MW**
Total	**48,200,000 MW**
Equates to:	**161,000 TWh**

Conclusion :

Demand	**3,200 TWh**
Supply	**161,000 TWh**
Supply v Demand	**x 50**

Mr Brian Hurley, Wind Site Evaluation Ltd.
Offshore Wind Resources in Europe
Marseilles, March 2009

Offshore Wind in the North Sea can meet Europe's need, 50 fold

Mainstream's Projects in the North Sea

Key Features

•**Excellent** wind resource

•**Convenient location** for major energy consumers

•**10 countries** are now focused & organised to developing this resource

•**Mainstream** has 3 projects in the North Sea:

- •Germany
- •Scotland
- •England

• **33,000 MW** of Offshore Wind Round 3 Development licences issued by Crown Estate in UK waters

Offshore Wind Farms in the North Sea will deliver the EU's Energy Strategy

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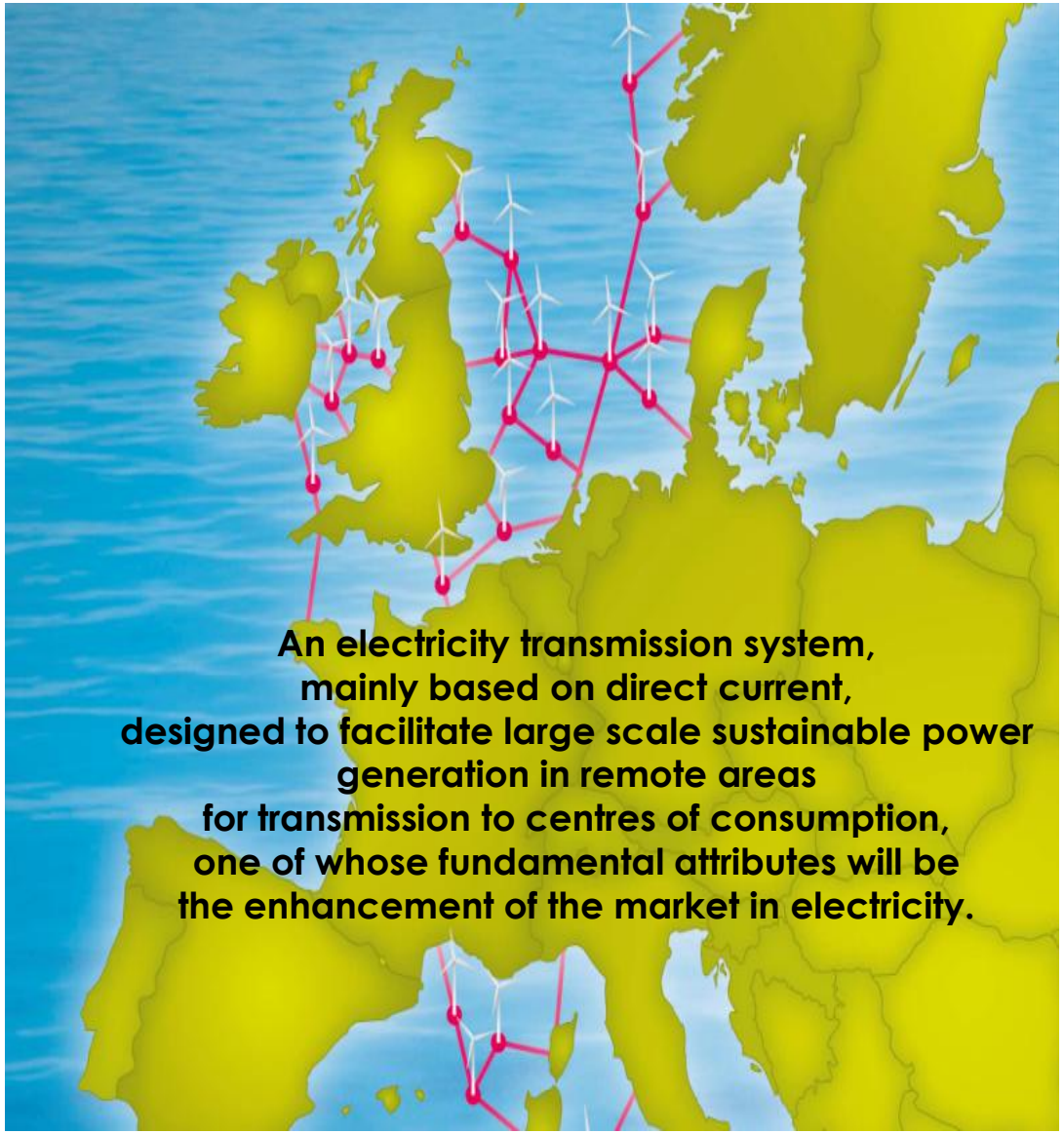
Supergrid



Key Features

•**A new transmission backbone** for Europe's decarbonised power sector

•**Enables distribution of energy** from 1,600,000 MW Offshore Wind Farms

•**A transformational approach** to electricity generation and distribution

•**Captures clean energy generation** and delivers firm renewable power across Europe

•**Goes beyond** existing point-to-point interconnectors

•**Innovative technology needed** to deliver HVDC Supernode technology

•**Requires a strategic partnership** across the Supply Chain

•Cost to build Europe's Supergrid;

€0.6 Trillion Offshore Supergrid
€0.6 Trillion Onshore Supergrid

The wind is always blowing somewhere; Supergrid creates portfolio effect

Supergrid Consortium

The consortium represents companies and organisations with a mutual interest in promoting the policy agenda for a European Supergrid.

CEO Ana Aguado runs the Consortium which exists to accelerate the Supergrid via a 5 point strategy:

1. Develop Standards
2. Create Offshore Transmission Operator
3. Establish EU Regulations
4. Create Single Electricity Market
5. Establish legal basis for trading

AREVA

DEME Blue Energy

elia Powering a world in progress

wpd think energy

MAINSTREAM RENEWABLE POWER

3E NOT FACING BUT SHAPING THE CHANGES

HOCHTIEF CONSTRUCTION AG

GE

Nexans

Visser & Smit Marine Contracting

SIEMENS

PRYSMIAN CABLES & SYSTEMS

Smart solutions. Strong relationships.

VATTENFALL

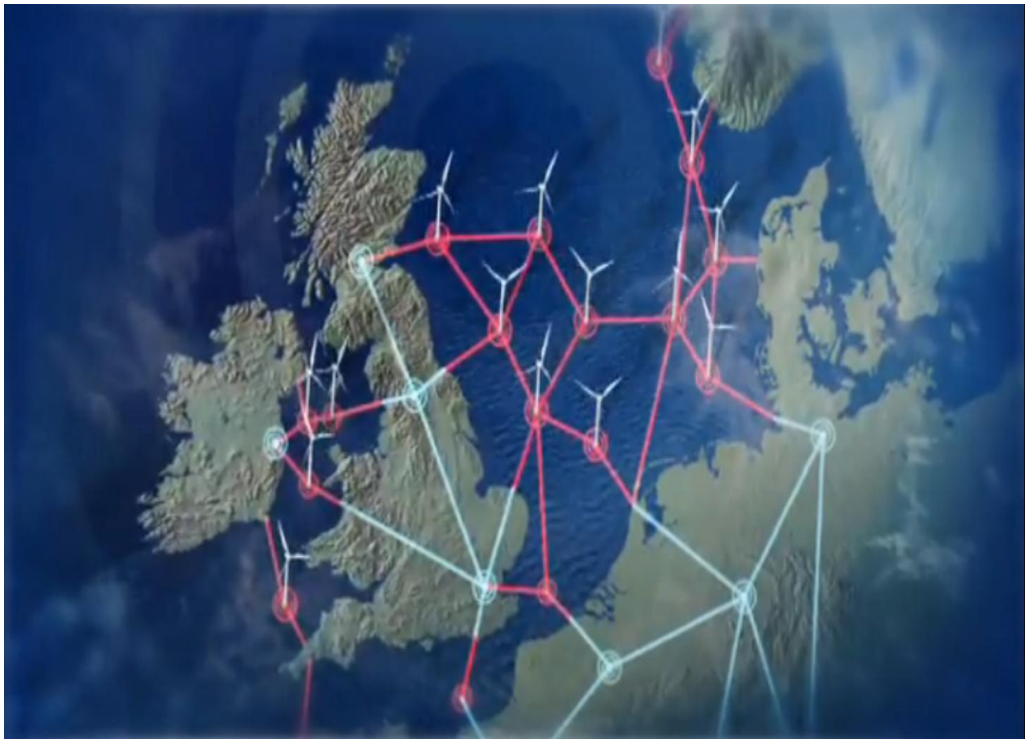
PB PARSONS BRINCKERHOFF

The Consortium has 20 members so far

Video : 2050 Supergrid

Click Here

Europe's Supergrid in 2050



7 Innovation Trajectories are needed;

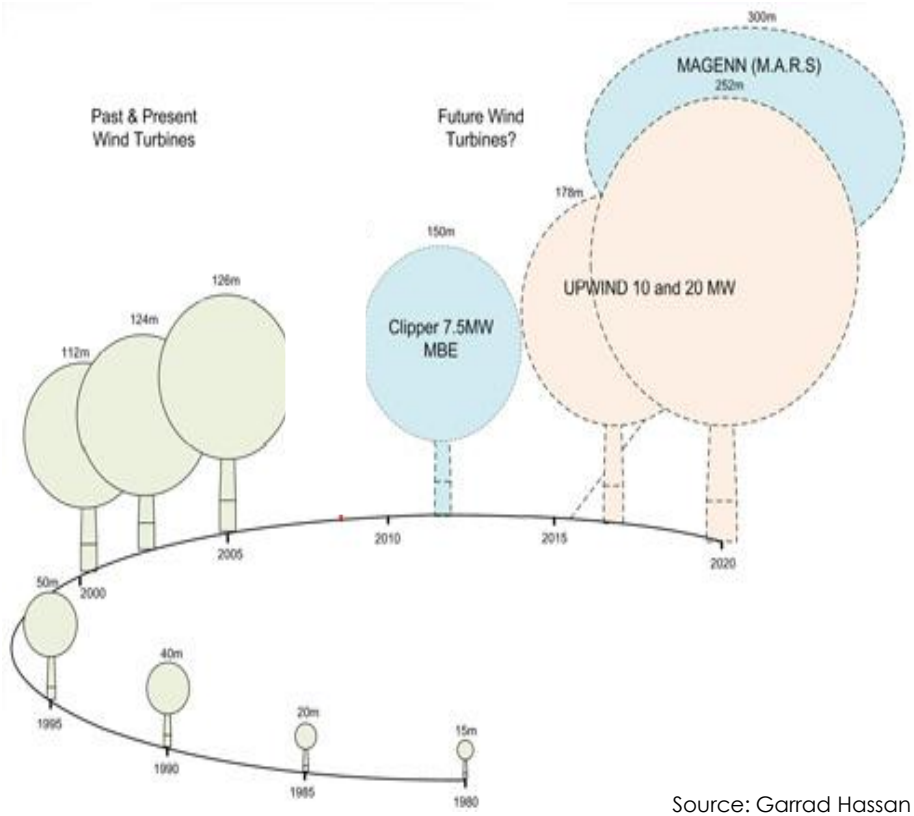
1. Bigger Wind Turbines
2. HVDC Transmission Cables
3. Supernode
4. Next-Generation Civil Engineering
5. Bigger Construction Vessels
6. Bigger Ports
7. Better ICT

Dr Eddie O'Connor, Mainstream Renewable Power
Supergrid Launch
London, March 2010

An inevitable transition to Sustainability with 7 Innovation Trajectories

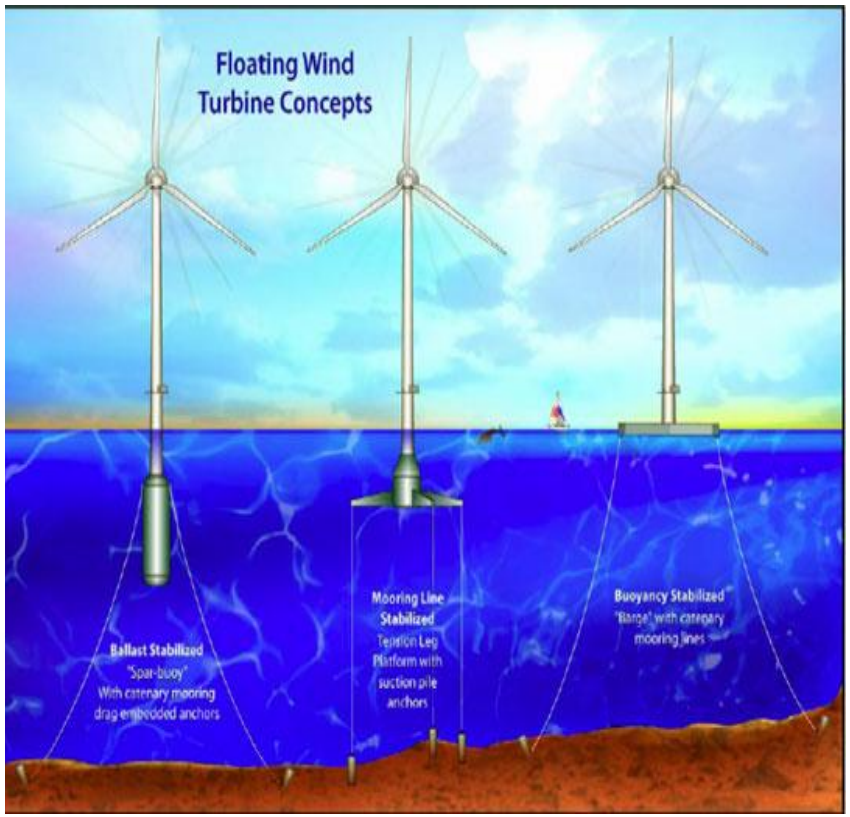
Innovation # 1 : **Bigger Wind Turbines**

Turbines will get bigger : 20 MW



Source: Garrad Hassan

Floating Turbines will be viable

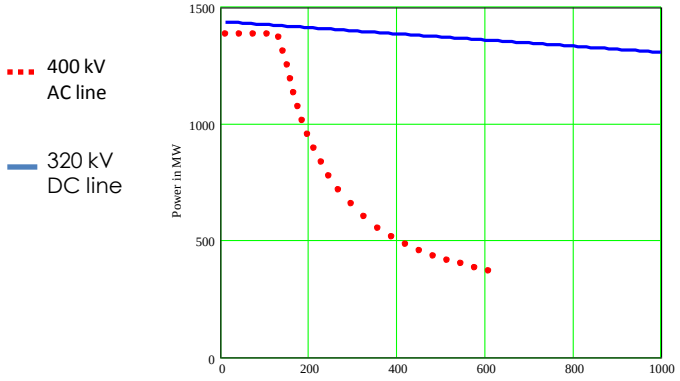


Dr Eddie O'Connor, Mainstream Renewable Power
C & F Offshore Summit
London, April 2009

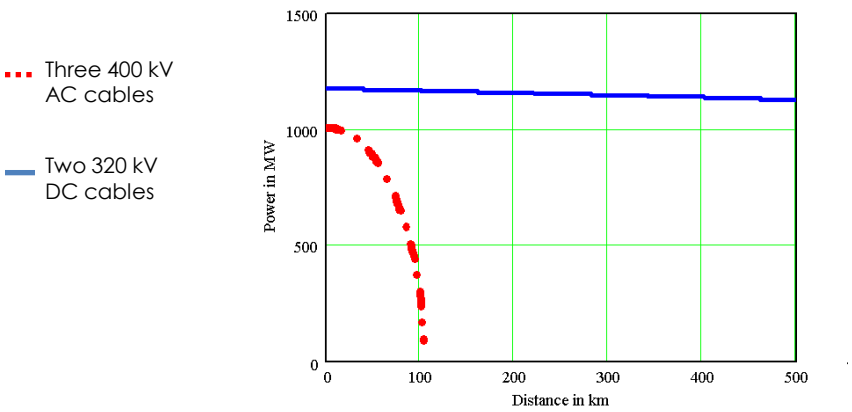
Bigger, better turbines are needed

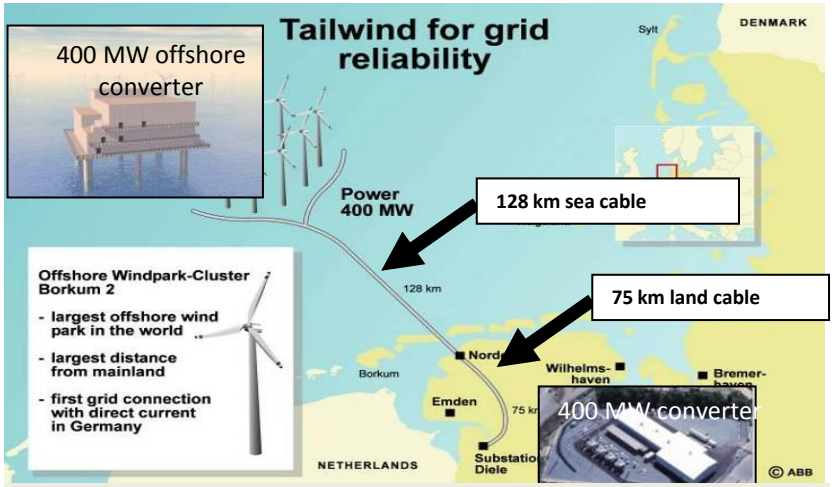
Innovation # 2 : **HVDC Transmission Cables**

Overhead Cables



Sea Cables



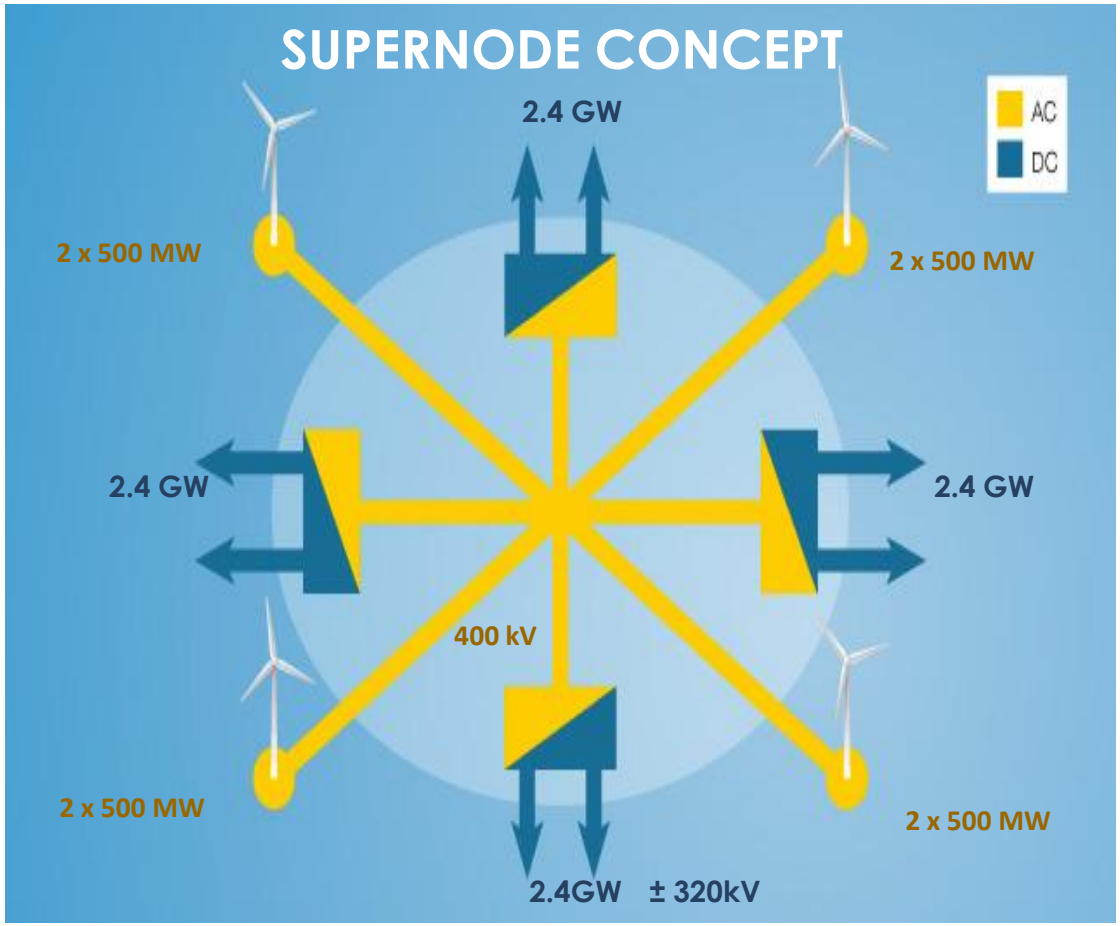


E.ON Netz, Borkum 2, 400 MW HVDC Light

Mr Gunnar Asplund, ABB
HVDC Supergrid - Technology and Costs
Marseilles, March 2009

HVDC uses proven technology

Innovation # 3 : **Supernode**



*"**In 2011, only 30%** of all power generated uses power electronics somewhere between the point of generation and end use.*

***By 2030, 80%** of all electric power will flow through power electronics."*

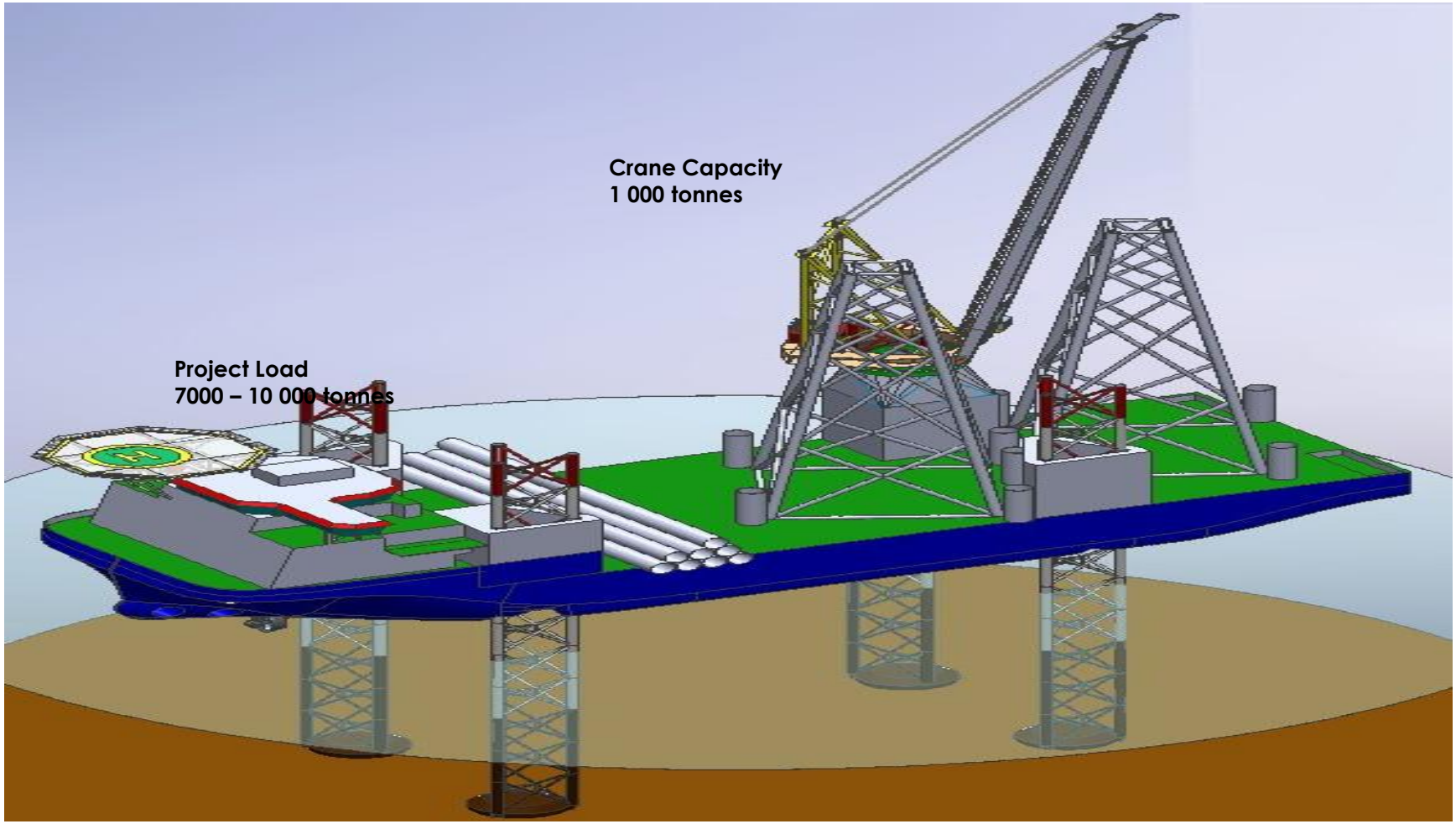
Office of Electric Delivery & Energy Reliability,
US Dept of Energy

Mr Joe Corbett, Mainstream Renewable Power
Detailed design of the Supernode
Marseilles, March 2009

Supernode is a proven concept

Innovation # 4 : **Next Generation Civil Engineering**

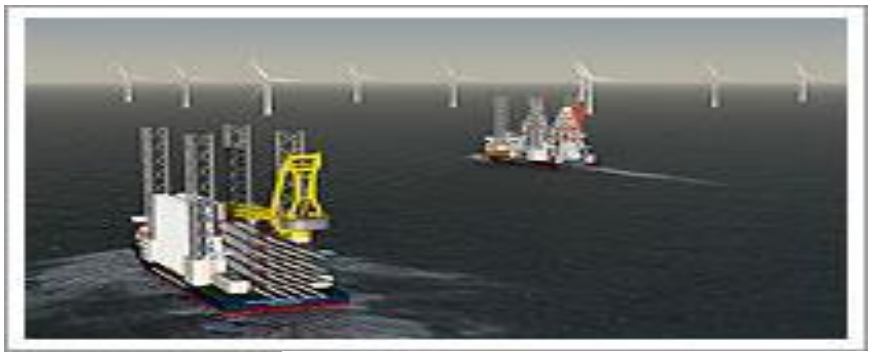
Offshore wind Jack-up



Mr Fenno Leeuwerke, Hochtief Construction
Building at Sea and 3rd Generation of Ships
Marseilles, March 2009

Bigger, stronger Jack-up Technology

Innovation # 5 : **Bigger Construction Vessels**



Mr Fenno Leeuwerke, Hochtief Construction
Building at Sea and 3rd Generation of Ships
Marseilles, March 2009

Bigger Ships for bigger loads

Innovation # 6 : **Bigger Ports & Better Logistics**

Requirements for UK's Offshore Plans;

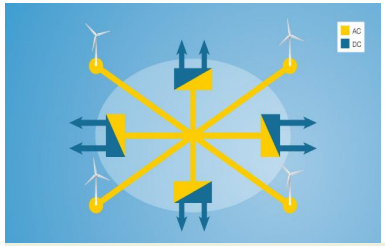
- Develop two completely new ports
- One on either coast of the UK
- More than transport nodes
- Focal point for regional development
- Centres of excellence for R + D
- Training centres for technologists/technicians
- New manufacturing centres

Dr Eddie O'Connor, Mainstream Renewable Power
C & F Offshore Summit
London, April 2009

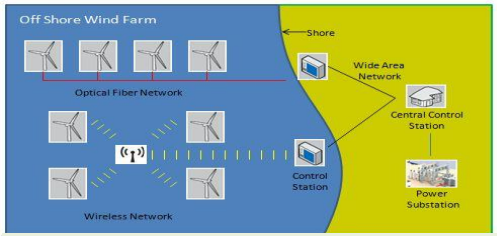
An entirely new approach to Logistics is needed

Innovation # 7 : **Better Information Technology**

Power Distribution Management

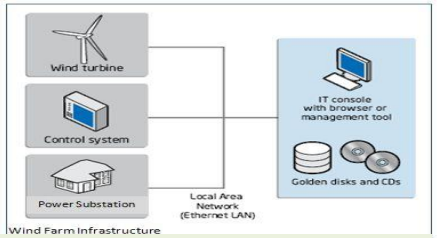


Supernode Power Controls

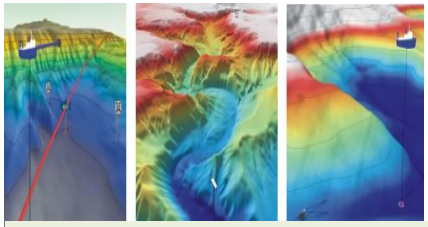


Hi-Speed Wireless Communication

Monitoring & Controlling Risk



Wind Turbine Control Systems



Surveying & Modelling the Sea

John Shaw, Mainstream Renewable Power
ICT Strategy for Offshore Wind

Better ICT will add value throughout the business process

Video : 2050 Forward

Click Here

Better ICT will add value throughout the business process

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Offshore Business Process

5 % of the € 6.4 Trillion investment will be for ICT
Equates to € 320 Billion ICT investment

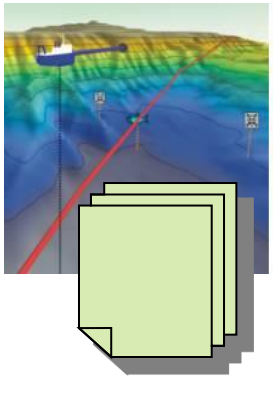
Survey

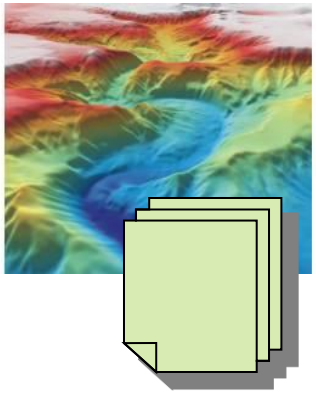
Construct

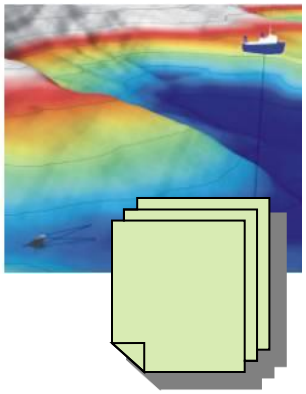
Operate

Business needs to...

Identify & Mitigate Risks
Accelerate Surveying
Accelerate Construction
Connect & Distribute Power







Information needed :

Surveying
Modelling
Turbine Control Systems
Wireless Communication
Power Distribution Management
Project & Document Management
Risk Management

Reducing Risk is all about Data

What Offshore Wind Developers Need from ICT

- **Mainstream's fundamental belief is that marine data is a Public Good.**
  - It should be collected once and used many times.

- **Key needs ;**

  - **Accessibility and Management:**
    - **Clear policy of ownership**, licensing & access for all publicly funded data collection
    - **Single point of access** to marine data and information
    - **Discourage cost-recovery pricing** from public bodies

  - **Data Standards and Quality control:**
    - **Common standards** across jurisdictions and disciplines
    - **Ensure the above is addressed** in publicly funded data collection contracts

  - **International Coordination:**
    - **Harmonised approach** across the EU in relation to all of the above:
    - **Links** provided and maintained to EU/global databases and initiatives

- **Benefits of improved data management ;**
  - **Measurable reductions in costs** to find, access and retrieve data
  - **Wider and more reliable** data and information upon which to base assessments
  - **Mechanisms to share results** and data with stakeholders

Offshore Wind Energy Developers want to reduce Project Risk

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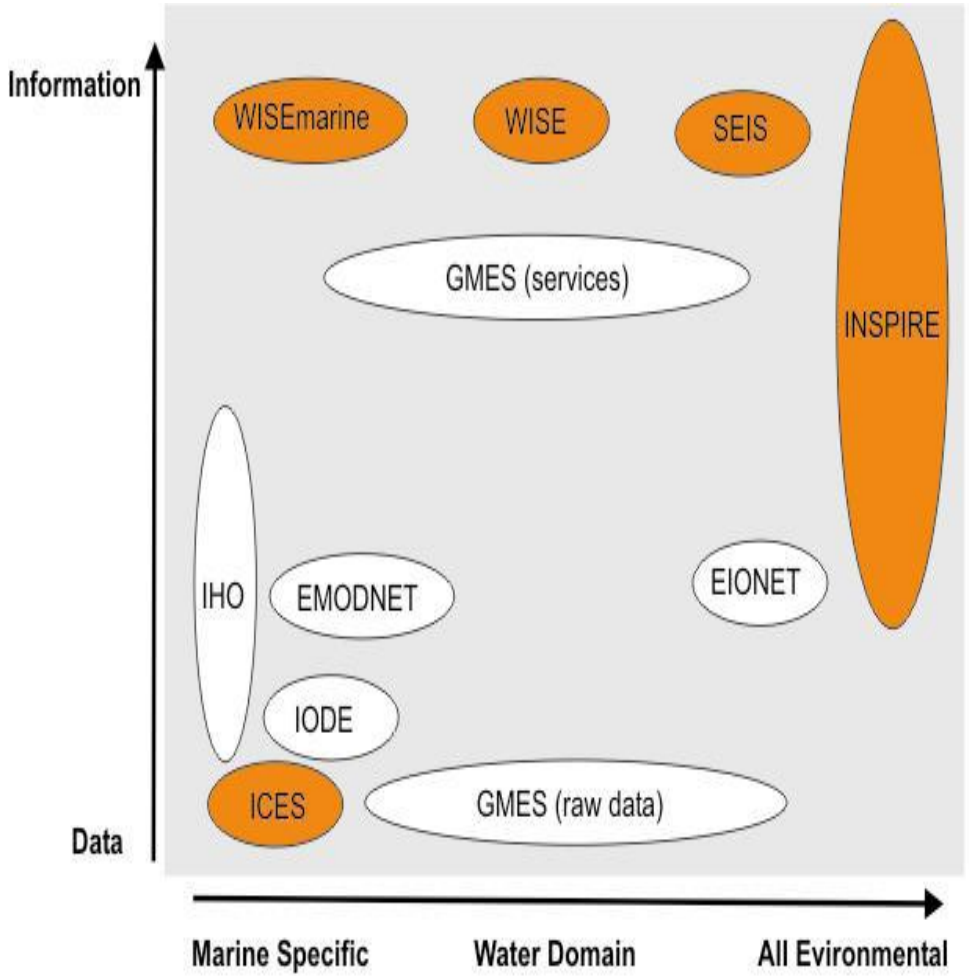
EU & Marine Data Management



Shading = initiatives to manage data to satisfy EC Legislation

- 4 EU Directives in particular impact industry:
  - **Marine Strategy Framework Directive –** *'establish and implement coordinated monitoring programmes for ongoing assessment of the environmental status of [member state] marine waters'*
  - **INSPIRE Directive** – *'adopt measures for the sharing of data sets and services between public authorities for the purpose of public tasks and the Environmental Information Directive'*
  - **Birds and Habitats Directive** – *'establish a network known as Natura 2000 (SPA, SACs)*
  - **Data Collection Framework for Fisheries** – *'collect, manage and provide high quality fisheries data for the purpose of scientific advice, mainly for appropriate fisheries management decisions'*

There are many directives and initiatives underway

Marine Knowledge 2020

Marine Knowledge 2020 :
Marine Data and Observation for Smart and Sustainable Growth

Launched 13 September 2010

Led by Iain Shephard

Key Objectives

This Initiative from the Commission will ensure the following are achieved ;

- ***Data from the EU-supported*** *research programmes are more available for re-use*
- ***Common*** *standards and policies*
- ***Contribute towards*** *an interoperable global marine knowledge system*

Cost

- €110.0 Million spent per year by EU on marine data collection
- € 18.5 Million additional allocation per year for EU's Marine Knowledge 2020 initiative

Offshore Wind Developers need to contribute to Marine Knowledge 2020

IMarEST Offshore Renewables Special Interest Group

The Institute of Marine Engineering, Science and Technology (IMarEST) is the leading international membership body and learned society for marine professionals, with over 15,000 members worldwide.

Special Interest Group established for Offshore Renewables. December 2010

Led by John Sturman, *Chairman, IMarEST Offshore Renewables SIG*

Aim is to be <u>the</u> global professional organization that represents the offshore renewables industry.

Important activities will include knowledge sharing amongst members, policy formulation and standard setting.

An ICT Working Party is in place.

IMarEST Offshore Renewables SIG will help drive ICT Standards

MEDIN

The UK Marine Environmental Data and Information Network (MEDIN) is a collaborative partnership driving improved management and access of marine data.

Key Achievements

01 September 2010

- Wide public and private sector involvement ; 30 organisations, including Mainstream
- Created a set of common standards : Tender Specification Clause
- Established 4 Data Archive Centres (DAC) Network : priority public marine data sets
- Launched web portal ; central search capability http://www.oceannet.org/

Key Gaps

- No obligation for Industry-collected data
- Granularity for project-specific data storage
- No 3D Visualisation, No Simulation

MEDIN define many standards for data collection in UK waters

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Step 1: **Business Process**

	Generation	Energy Supply (Wholesale/Trading)	Delivery (Trans / Distribution)	Customer Service (Retail)	Shared Services (Corp/Enterprise)
Business Processes	**Generation asset management** **Operation Management** Fuel Management	**Energy Commodity Management**	Delivery (T&D) Asset Lifecycle Management Network Operation Management **Work Management**	**Customer Lifecycle Management** Revenue Cycle Management*	Supply Chain Management **IT portfolio and asset management** **Finance / Administration** **Human Resources Management** **Legal / Regulatory affair Management** Enterprise Risk Management **Strategy Planning**
Business Systems	**Document Management** **Asset Management** **Predictive Performance** Fuel Management Emissions Optimisation	**SCADA** Load Forecasting Demand Response Clearing & Settlement Meter Data Management	**Development Analysis** Field Force Enablement (mobility) Field Force Enablement Outage Management Network Design	**Customer Relationship Management** Complex Billing	**Finance & HR** **Project Management** **Business Intelligence** Enterprise Risk Supply Chain

Source: Microsoft Utilities Strategy

8 Business Systems to meet Business Process needs

Step 2 : **Business Priorities**

Mainstream Business Priorities vs Business Systems	Document Management System	Finance & HR System	Development Analysis System	Project Management System	Asset Management System	Predictive Performance System	Customer Relationship Management System
1. Develop & construct Robust Pipeline.	●	●	●	●			
2. Monitor other 'fuel-free' technologies.	●						
3. Partner with Local Developers.	●	●	●				
4. Leverage Central Expertise.	●	●	●	●	●	●	●
5. Offshore position as Early-Stage Partner.	●	●	●				
6. Sell projects to Utilities & Investors.	●	●	●		●	●	●
7. Recycle cash from Sale of Assets.	●	●			●	●	
8. Seek liquidity event / IPO for investors.	●	●			●	●	
Underlying Standard IT technology;							
Management Information always available.	Business Intelligence & Reporting System						
Service Excellence.	Standard PC / Print / Wireless Access / Telephony / Video Conferencing						

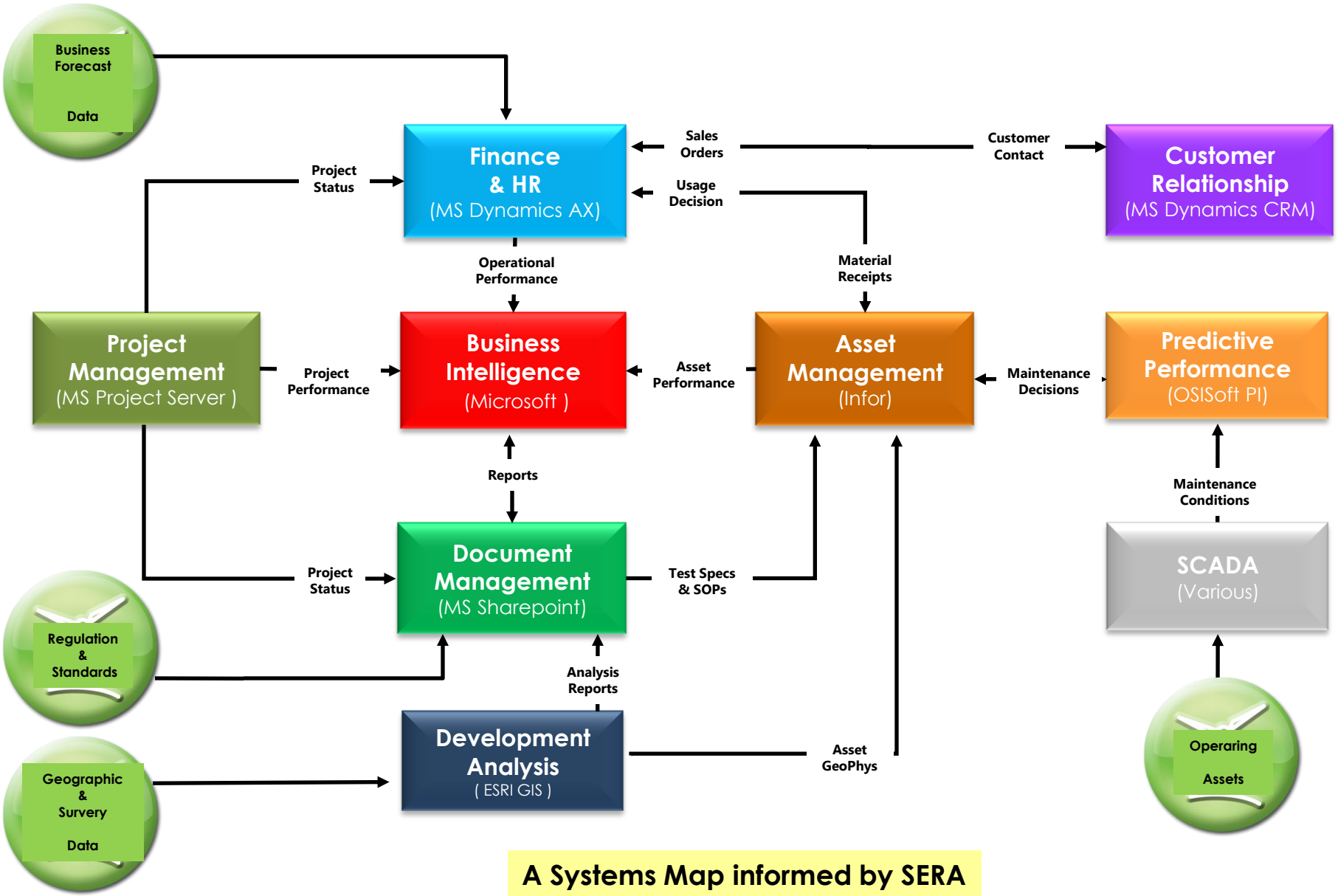
8 Business Systems to achieve Business Priorities

Step 3 : **Business Systems Vision**

Business Need	Integrated Business Systems	Value
Deal Making	Document Management	Collaboration & Fast Replication
Cash generation & Management	Asset Management, Finance & HR, Development Analysis, Project Management	Efficient Work Flow
Project Execution	Predictive Performance, Customer Relationship Management	A Single Version of the Truth
	Business Intelligence	Faster Decision-Making
		Increase Personal & Team Productivity

8 Integrated Business Systems to deliver Value

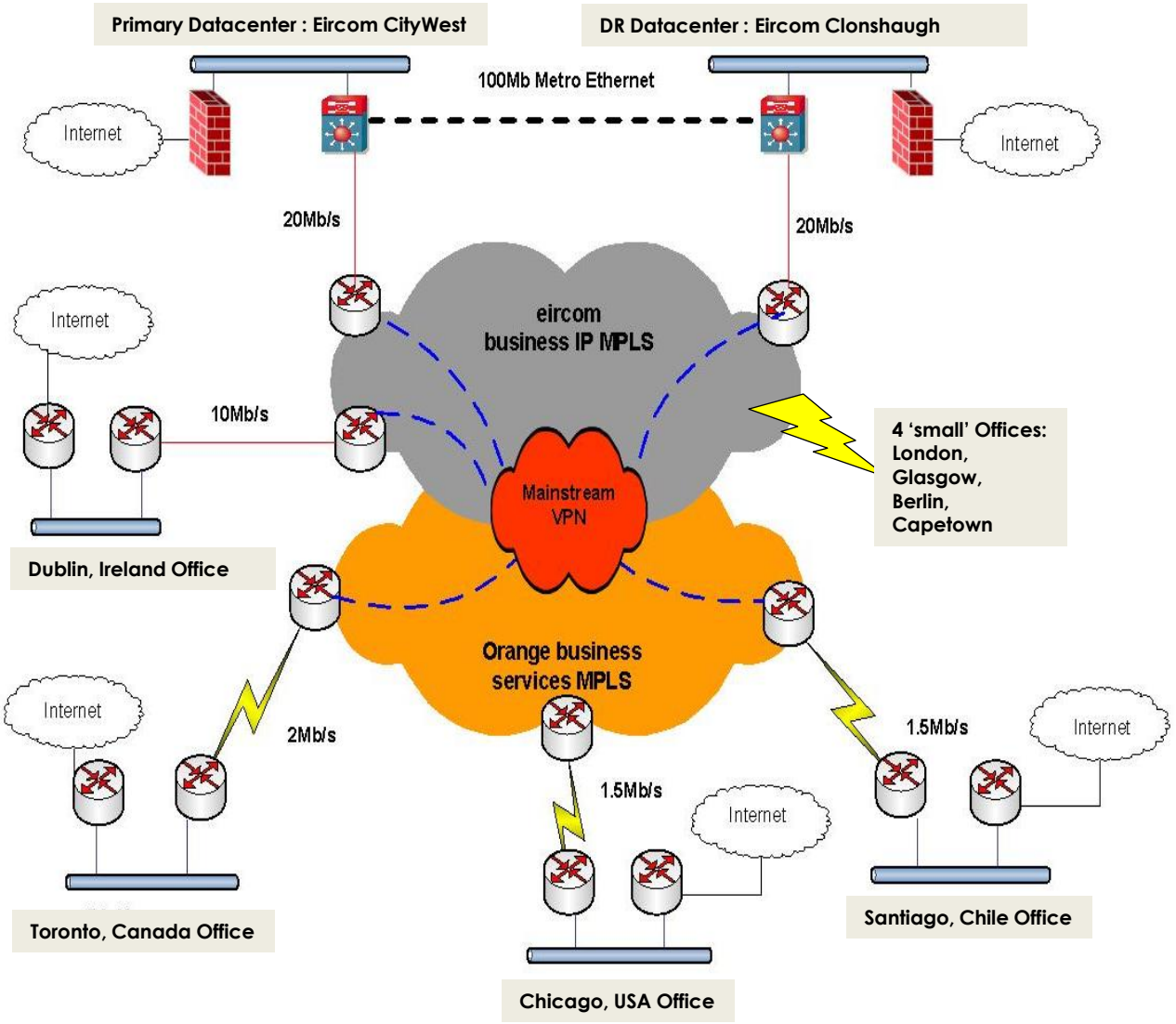
Step 4 : **Business Systems Map**



A Systems Map informed by SERA

Step 5 : **ICT Infrastructure**

SCHEMATIC



PARTNERS

- Microsoft : Software
- Eircom-Orange : Communications
- HP -DSS : Hardware

STANDARDS

- Microsoft : 29 Products
- HP : Client & Infrastructure h/w
- Cisco : data
- Nortel : Voice
- Polycom : Video

PRINCIPLES

- Aligned with SERA
- Build for global growth
- Build for 24 x 7 availability
- Build for Security
- Standardise components
- Configuration not customisation
- Partner with Strategic ICT vendors
- Service Level Agreements

A Private Cloud built for High Availability, Security, Performance

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Convert Data into Wisdom

Offshore Data Types

Depth Bathymetry
Wrecks Magnetometer
Seabed Sidescan Sonar
Sub-Strata Boomer
Mapping ESA Satellites

Wind MetMast, Lidar

Foundations Geotechnics

Waves & Currents Oceanography

Flora & Fauna Ecology

Regulatory Reports Consultancy

Risk Prediction & Mitigation

An Integrated Sea Information System (ISIS) is needed : doesn't currently exist

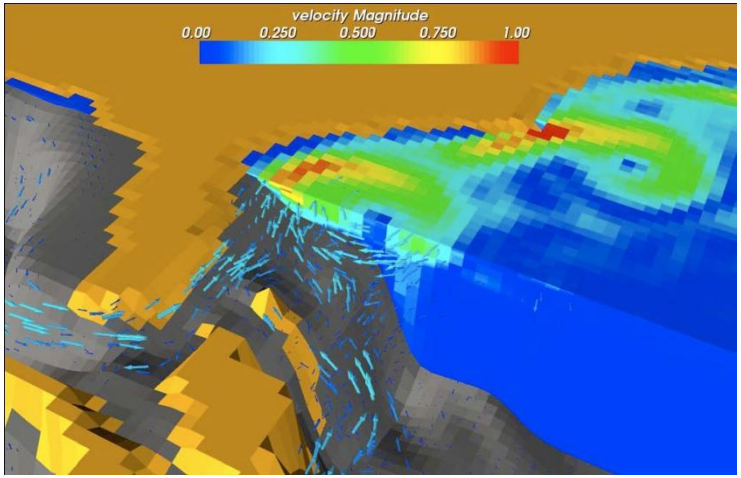
Precedent: **3D Data Visualisation**

Pittsburgh Supercomputing Center (PSC) computational scientist consultants work closely with discipline scientists to provide tools for visualization and analysis on their Cray XT3.

"too much information.": When it comes to a scientist's desire to simulate physical phenomena in realistic detail, there is no such thing.

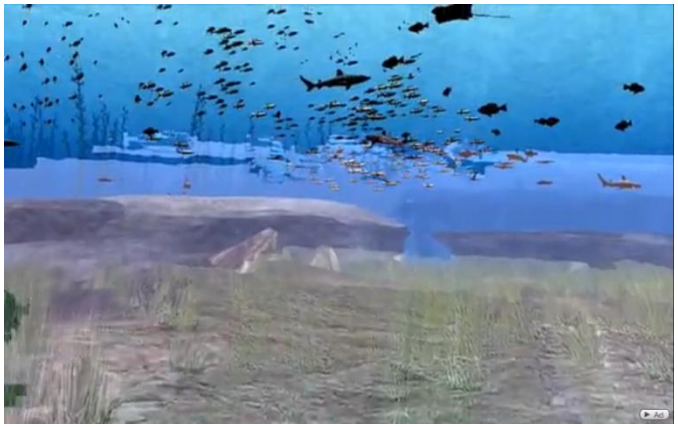
3D visualisation of Atlantic Currents

University of Miami & PSC



Realtime Ocean Visualisation

Lenfest Ocean Future Blender 2.48



http://www.youtube.com/watch?v=Z5Q1Pwrp8bw&feature=youtube_gdata_player

Basic Visualisation technology exists

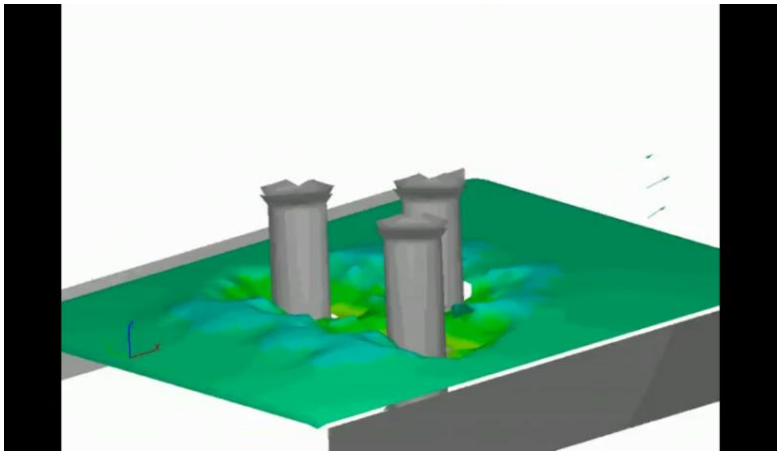
Precedent: **Running What If Scenarios**

Visualising data makes it easier to identify risk.

Simulating scenarios makes it easier to predict future risk.

Sediment Scour Simulation

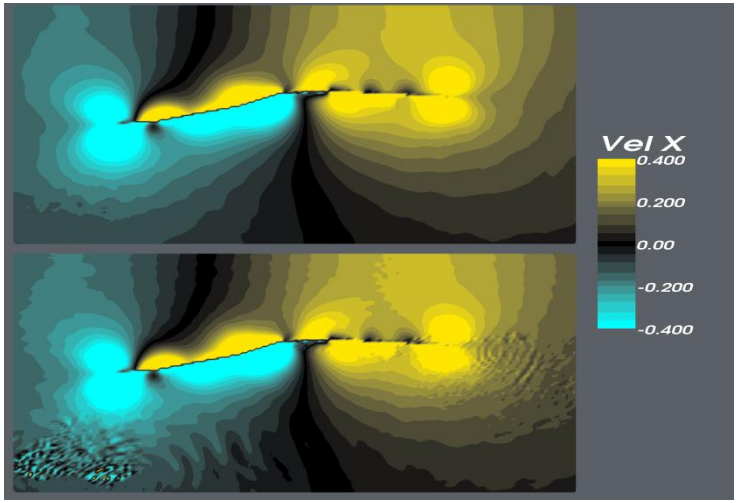
Northwest Hydraulics Consultants. CUDA



http://www.youtube.com/watch?v=NlGzrlslhQg&feature=youtube_gdata_player

3D visualisation of Soil Displacement

Carnegie Mellon University & PSC



Basic Modelling Technology exists

ICT Strategies for The Supergrid

- Mainstream Renewable Power
- Offshore Wind in Europe
- Supergrid Enablers
- Offshore Wind Developers' ICT needs
- EU Data Management initiatives
- Mainstream's Current ICT Strategy
- The need for ISIS: "Integrated Sea Information System"
- **Next Steps**

Step 1. Form ISIS Consortium; prospective members

FRIENDS OF THE SUPERGRID

European Commission
Maritime Affairs and Fisheries

Marine Institute
Foras na Mara

MAINSTREAM RENEWABLE POWER

MEDIN
marine environmental data & information network

NUI MAYNOOTH
Ollscoil na hÉireann Má Nuad

intel

Microsoft

Institute of Marine Engineering, Science & Technology
IMAREST

The consortium must represent all key stakeholders

Step 2. Agree The ISIS Problem Statement

Business Problem :

As Europe expands Offshore Wind Energy, Developers need to collect and analyse large quantities of data and meet regulatory requirements. In the absence of an Integrated Sea Information System, a variety of methods will be used to collect, store, analyse and compile data leading to delays and inefficiencies.

	Current State	Integrated Sea Information System (ISIS)
Work Flow	Inefficient, disparate methods across the Offshore Industry, No agreed workflow methodologies exist across multiple stakeholders.	Integrated Approach
Single version of the truth	No single data repository exists, No single data analysis methodology exists. Difficult to move between 3rd party providers of data	**Integrated approach to data management**. all collected data stored in a single n-dimensional database, standardised visualisation method
Speed of decision-making	Risks not captured in unitary manner	**Integrated approach to risk management**: rule-based decision-making to predict and mitigate risk, to identify trends and patterns, to run what-of scenarios, to peer into the future
Fast Learning	Difficult to move between 3rd Party providers of data	**Integrated approach to Knowledge Management**. standard Reports for Regulatory Compliance
Security	Loose Security: Position unknown, difficult to enforce.	**Complies with ISO27001**. Tight Security :Position known, protected.
Cost	High repeating cost for individual organisations. High Total Cost of Ownership.	**Low Total Cost of Ownership**. Initial high cost to develop, lower cost to operate, all stakeholders share the cost.
Personal & Team Productivity	Inefficient	**Satisfy all Stakeholders with one system**. Clear, Single Repository for all Data. Measure Once, Use Manage times, Open Systems Standards

ISIS : faster, better, more reliable, more secure

Step 3. Identity & Address ICT Barriers

- **Innovation is inhibited by data licence issues:**
  - **Data licence issue** throughout European waters
  - **Over 400 legal entities** have licensed ownership of data in Britain
  - **Need EU Data Ownership Policy**

- **Innovation is inhibited by regional data strategy variation:**
  - **National data archives** are at different levels of maturity
  - **Low Interoperability** of data and metadata across EU
  - **Need EU standard** for data archives

- **Role for EU Commission:**
  - **Build on existing progress** made by data communities
  - **Provide sustainable funding** for Innovation
  - **Provide framework** for licensing and re-use of data

- **Role for ISA:**
  - **Build on existing ISA standards** in other Sectors (eg Manufacturing)
  - **Align with relevant IEEE standards** for computer & electrical devices
  - **Provide framework** for developing integrated standards across supply chain

There is a compelling need for Standards

Conclusion

The Energy Sector is undergoing A Technology Transformation as it moves to Renewable Sources

Mainstream is a Growing, Global Renewable Energy Start-Up with a strong Projects pipeline

Better ICT, underpinned by Innovation, Standards and Collaboration, will accelerate Offshore Wind Energy Development

Further information

Mainstream : Business Model
http://www.mainstreamrp.com/

Mainstream's ICT Strategy, described by Silicon Republic
http://www.siliconrepublic.com/strategy/item/14728-in-the-mainstream

Intel & Mainstream : joint White-Paper & Video on Offshore Wind Farms
http://www.intel.com/embedded/energy/products.htm (see 'Wind Turbine Availability Excellence')
http://edc.intel.com/Link.aspx?id=4264
http://www.youtube.com/watch?v=oOlWSWujw8s

Microsoft & Mainstream : Blog on SERA adoption & link to SERA document
http://blogs.msdn.com/b/mspowerutilities/archive/2010/06/24/sera-succinctly.aspx
http://www.microsoft.com/industry/manufacturing/utilities/default.mspx (see 'Spotlight' Section for details on SERA).

DSS & Mainstream : Partnership in action
http://www.decision.ie/

Friends of the Supergrid : driving policy and standards
http://www.friendsofthesupergrid.eu/

EU Commission Marine Observation and Data Network Expert Group
https://webgate.ec.europa.eu/maritimeforum/node/1709
https://webgate.ec.europa.eu/maritimeforum/system/files/ISIS_Update_10March2011.pdf

Energy Trends : Oil refinery bottleneck report from Richard Branon & from US Military
http://peakoiltaskforce.net/wp-content/uploads/2010/02/final-report-uk-itpoes_report_the-oil-crunch_feb20101.pdf
http://smallwarsjournal.com/blog/2010/03/joint-operating-environment-20-1/

Innovation Value Institute
http://www.ivi.ie/

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