



Combining Ecosystem Services and Economic Valuation for Policy and Project Appraisal

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Questions for this presentation

- How can ecosystem services be used to support CBA/CEA?
- Are these tools fit for purpose for the appraisal of schemes with multiple objectives and benefits?
- Our approach
- Examples

Evidence for decision making

- Qualitative evidence
- Quantitative evidence
- Monetary evidence

- *Together and separately*
- Combining ecosystem services and economic valuation produces all these

Decision making context

- Policy, programme, project appraisal
 - Cost Benefit and Cost Effectiveness Analyses
 - Quantitative or monetary evidence on *all* services that change
- Markets for ecosystem services
 - Quantitative or monetary evidence on the service(s) which will be paid for
- Liability
 - Monetary evidence



Combining ecosystem services and economic valuation

- Bundled ecosystem services
- Multiple ecosystem services
- Single ecosystem service

The bundled approach

- Usually hectare of habitat area used as proxy
 - Assumes 1 ha of a given habitat in ideal condition provides all ecosystem services associated with that habitat
 - When 1 ha is lost *all* of its services (or a % of its services depending on the scenario) are lost

The bundled approach

- Appropriate for
 - When new habitat is provided
 - When habitat is lost
 - Could be for management measures or compensation for damage liability
- Does not have to be terrestrial habitats



Multiple and single ecosystem services

- Service(s) are measured and valued separately
- ‘final’ services that affect human welfare (including combination of services that give rise to final services)
- Not always possible to separate services

Multiple and single ecosystem services

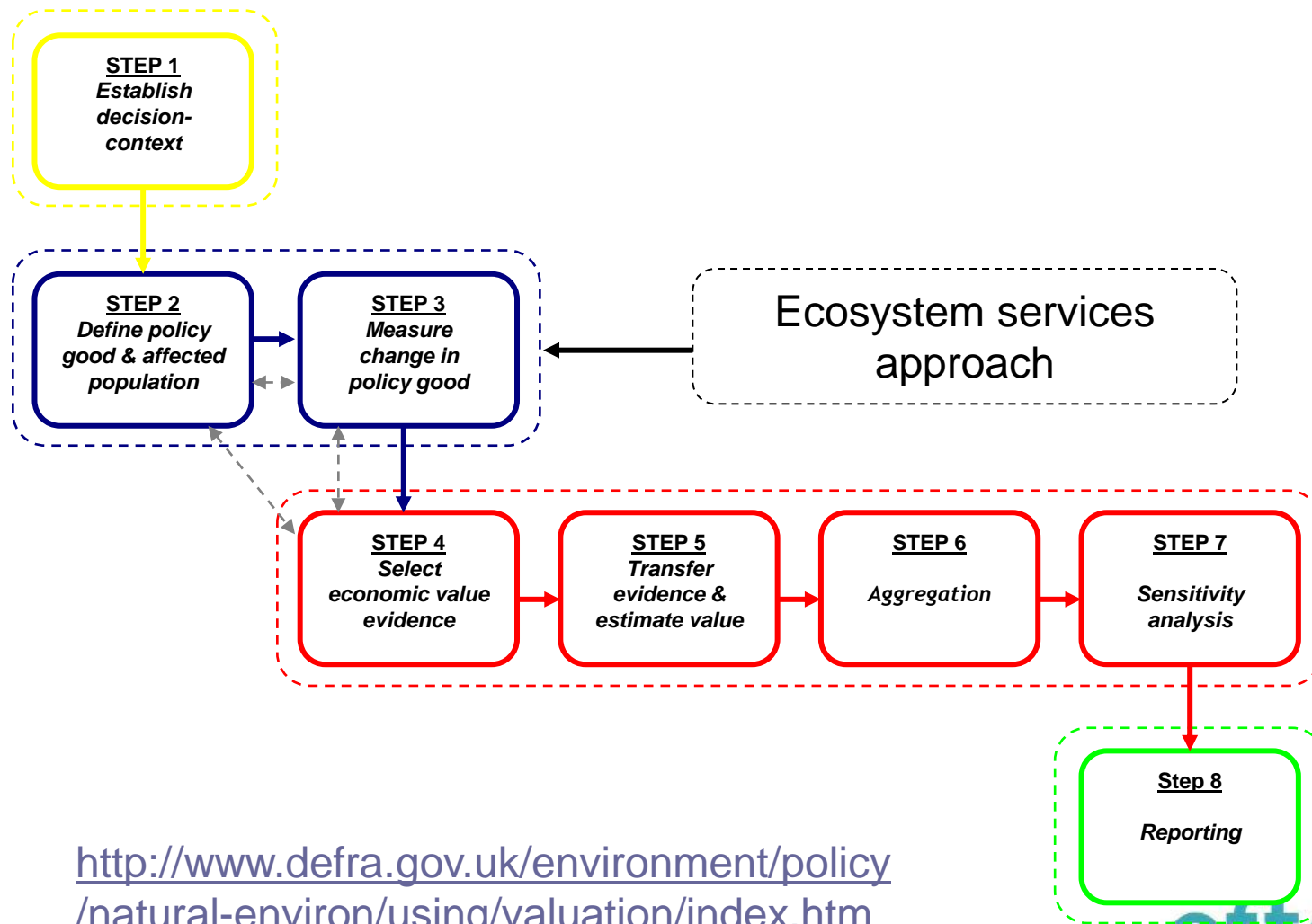
- Appropriate for
 - Decisions that affect some services and not others
 - Decisions that affect some services positively, others negatively
 - Payments (markets) for different management measures that provide the service(s)



Economic value estimates

- Primary valuation
 - Market values
 - Revealed preference
 - Stated preference

Value transfer steps



<http://www.defra.gov.uk/environment/policy/natural-environ/using/valuation/index.htm>

Examples

- The bundled approach
 - EA **Flood and Coastal Erosion Risk** Management Handbook
 - Valuing the environmental changes due to the **Severn Tidal Barrage Options** for DECC
- Multiple ecosystem services
 - **Forestry Commission Estate**
- Single ecosystem services
 - **Carbon sequestration & emissions from Severn tidal barrage**



Bundled approach – EA Flood and Coastal Risk Management - economic value evidence handbook

EA FCERM – EVEC Handbook

- Incorporating the environmental benefits
 - First cut – bundled approach: £/ha of habitat created, useful for initial negotiations
 - Second cut – a more detailed value transfer application, could take multiple services into account
 - Third cut – primary valuation research

<http://publications.environment-agency.gov.uk/pdf/GEHO0310BSFH-e-e.pdf>

EA FCERM – EVEC Handbook

Step 1:
FCERM options

Step 2:
Specify environmental baseline

Step 3:
Environmental effects

Step 4:
Define and quantify the affected population

Step 5:
Economic value of environmental effects

Step 6:
Calculate monetary costs and benefits

Step 7:
Sensitivity analysis

Step 8:
Combine monetary and non-monetary expressions of environmental effects

Step 9:
Reporting

CONTEXT
FOR VALUATION

VALUE
TRANSFER

SENSITI
VITY

REPORTING

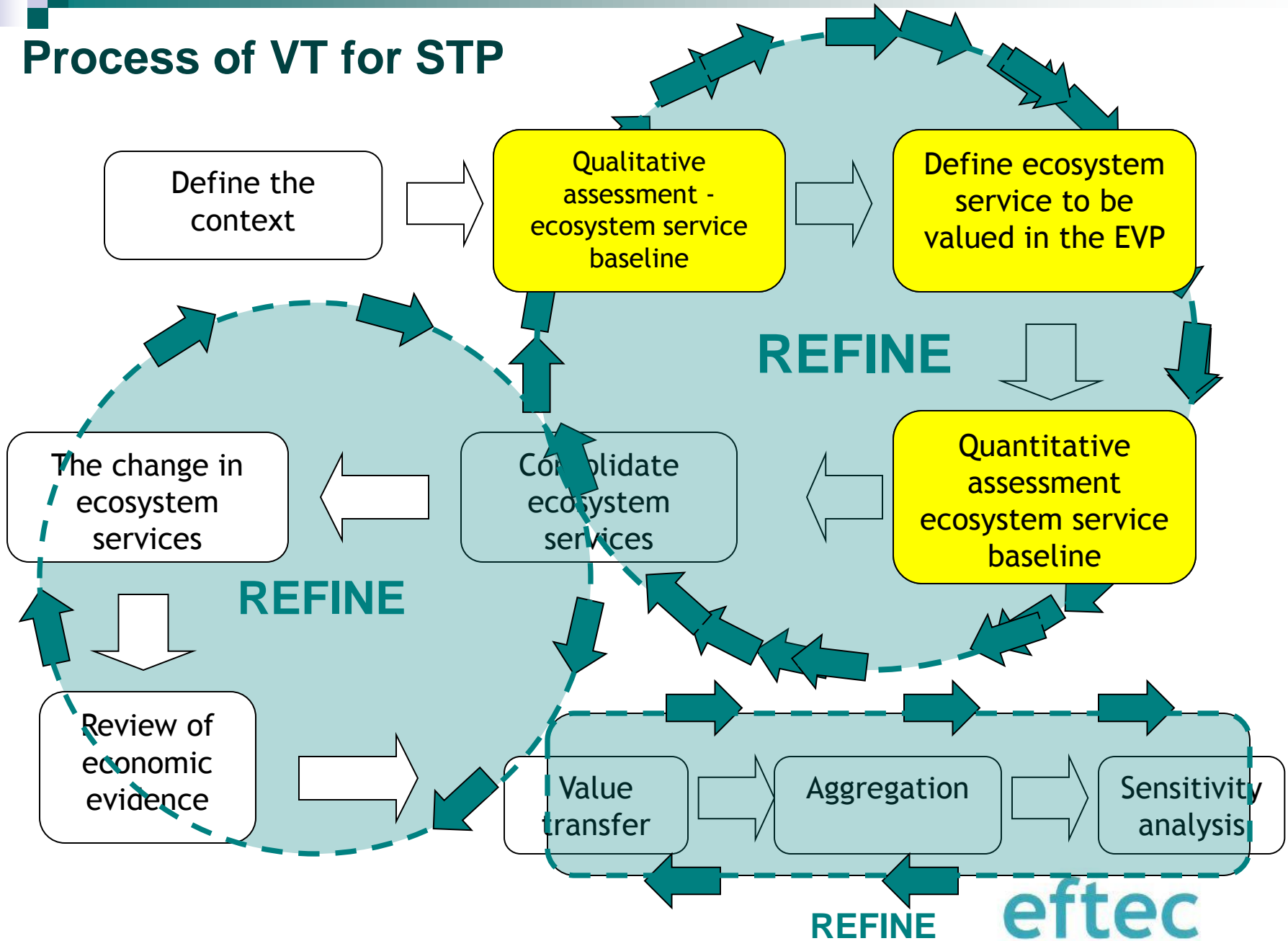
Reference:

- Case studies:
 - Paul Holme Strays, Humber Estuary
 - Alkborough Flats, Humber Estuary
 - Wareham
- Published by the Environment Agency for England and Wales
- <http://publications.environment-agency.gov.uk/pdf/GEHO0310BSFH-e-e.pdf>



Bundled approach – Severn Tidal Power (STP) Options for DECC

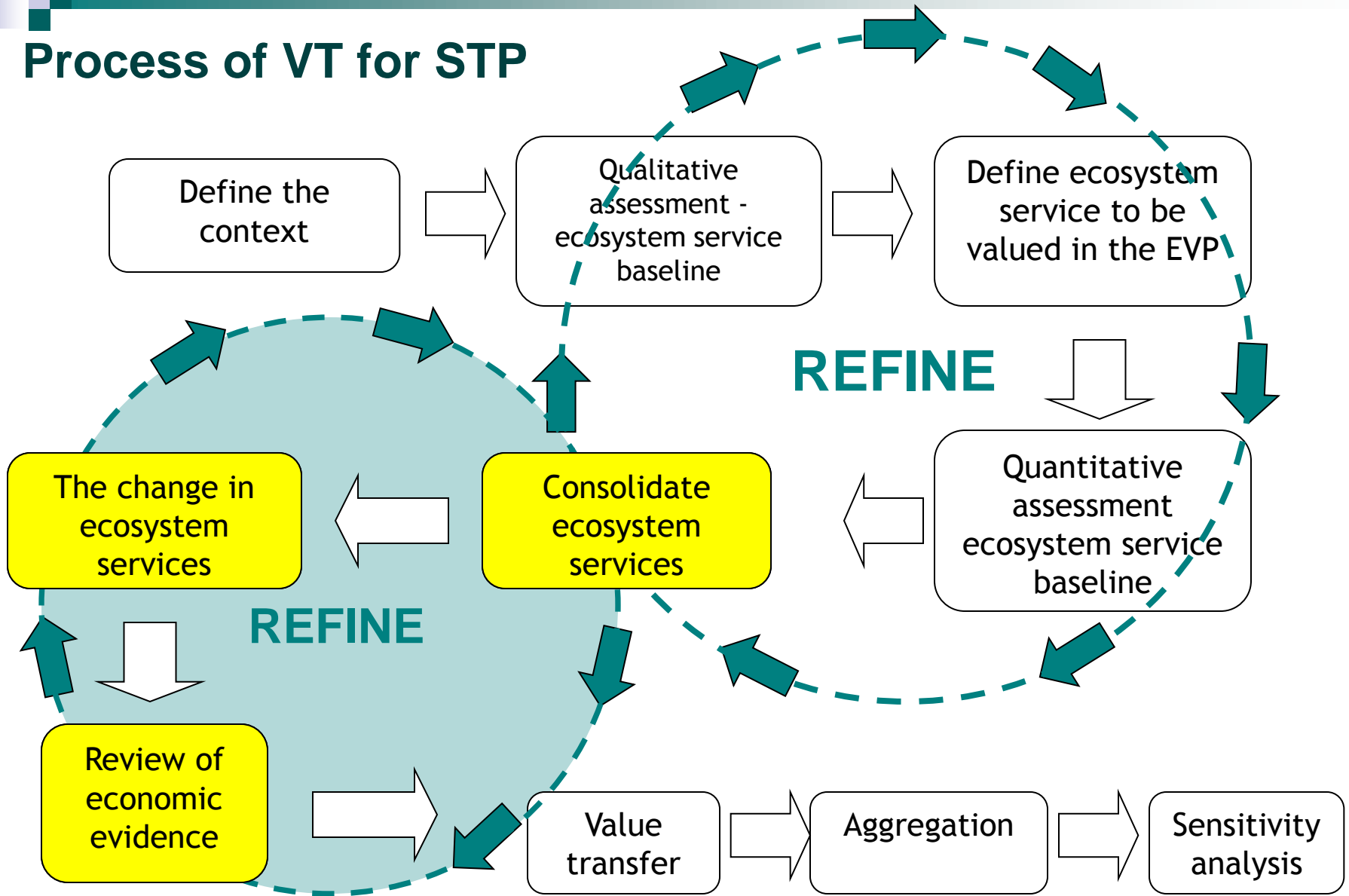
Process of VT for STP



| Ecosystem services | | FW Wet-lands | FW Rivers & Streams | Inter-tidal | Salt marsh | Sub-tidal | Terrestria |
|---------------------------------------|--|--------------|---------------------|-------------|------------|-----------|------------|
| PROVISIONING | | | | | | | |
| Food | Commercial fish catch (F) | - | ● | ○ | - | ● | - |
| | Shellfish catch (F) | - | - | ○ | - | ○ | - |
| | Grazing for cattle and sheep | - | - | - | ● | - | ○ |
| | Subsistence level fishing & cropping (F) | ○ | ○ | ○ | ○ | ○ | ○ |
| | Wildfowling | - | - | ● | ● | - | ● |
| Fibre/ materials | Fibre and construction prods (e.g. reeds, wood, leather, aggregates) | ○ | ○ | ○ | ○ | ● | ○ |
| | | - | - | - | - | - | ● |
| | | - | - | - | - | - | ● |
| | Developed Land | - | - | - | - | - | ● |
| Fuel | Renewable energy (F) | ○ | ○ | ○ | ○ | ● | ● |
| Water | Water for industrial usage | - | ○ | - | - | - | - |
| | Water for agricultural usage | ○ | ● | - | - | - | - |
| | Regenerative services | ○ | ○ | ○ | ● | ● | ● |
| | Maintenance of surface FW stores | ○ | ○ | - | - | - | - |
| | Groundwater replenishment | ○ | ○ | - | - | - | - |
| Natural medicines | Natural medicines | ○ | ○ | ○ | ○ | ○ | ○ |
| Biochemicals | Biochemicals and genetics | ○ | ○ | ○ | ○ | ○ | ○ |
| Ornamental resources | Ornamental resources | ○ | ○ | ○ | ○ | ○ | ○ |
| REGULATING | | | | | | | |
| Climate/climate change | C sequestration (F) | ○ | ○ | ○ | ● | ● | ● |
| Air quality | Air quality | - | - | - | ○ | ○ | ○ |
| Water reg. | Flood protection | ● | ● | ● | ● | - | ○ |
| Water purification & waste management | Filtration of water | ● | ● | ○ | ● | ● | ○ |
| | Detoxification of water and sed. | ● | ● | ● | ● | ● | - |
| Erosion regulation | Erosion regulation | - | ○ | ● | ● | ● | ● |
| Pollination | Habitat for bees | ○ | ○ | - | ● | - | ● |
| Bioremediation of waste | Beach cleaning? (F) | - | - | ○ | ○ | - | - |

| Ecosystem services | | FW Wet-lands | FW Rivers & Streams | Inter-tidal | Salt marsh | Sub-tidal | Terrestrial |
|---|--|--------------|---------------------|-------------|------------|-----------|-------------|
| CULTURAL | | | | | | | |
| Spiritual, religious, cultural heritage | Archaeological ruins (F - historical not recreational value) | ● | - | ● | ? | - | ● |
| | Heritage fishing | - | ● | - | - | ● | - |
| Recreation and ecotourism | Freshwater angling (migratory) | - | ● | - | - | - | - |
| | Freshwater angling (coarse) | - | ● | - | - | - | - |
| | Estuarine & sea angling | - | - | ● | - | ● | - |
| | Bird watching (F) | ● | ● | ● | ● | - | ● |
| | Hiking | ● | ● | ● | ● | - | ● |
| | Diving | - | - | - | - | ○ | - |
| | Sailing, canoeing, surfing etc | - | ● | - | - | ● | - |
| | destination (incorporates views) (F) | ● | ● | ● | ● | ● | ● |
| | Archaeol. ruins (F - rec.value) | ● | - | ● | - | - | ● |
| Landscape and amenity | Views (part of rec. above) AAF | ● | ● | ● | ● | ● | ● |
| | Visiting the Bore | - | - | - | - | ● | - |
| SUPPORTING | | | | | | | |
| Soil form. & retention | Soil formation and retention | ○ | - | - | ○ | ○ | ● |
| Cycling processes | Cycling processes | ● | ● | ● | ● | ● | ● |
| Primary production | Primary production | ● | ● | ● | ● | ● | ● |
| Habitat provision | Habitat provision | ● | ● | ● | ● | ● | ● |

Process of VT for STP



REFINE

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Example consolidation of services

Final Ecosystem Services

| Ecosystem Service | Contributing Ecosystem functions | Final Service | Econ. Ev | Units |
|---------------------------------|--|--|----------|---------------|
| Food | Primary production, habitat provision, nutrient cycling, water quality, nursery functions | Commercial fish catch | MP | Kg |
| | | Value of recreational fish catch inc. heritage catch | MP | Kg |
| | | Commercial Shell fishing | MP | Kg |
| | Habitat provision (e.g. arable land), water for agricultural use, soil formation & retention | Grazing for cattle and sheep* | MP | Ha |
| Spiritual, Religious & heritage | Soil formation & retention | Archaeological ruins* | MP, NM | Visitor days |
| | Primary production, habitat provision, nutrient cycling, Water Quality | Commercial Heritage fishing (non-use values) | NM | |
| Recreational values | Primary production, habitat provision, nutrient cycling, water quality, landscape, biodiversity. | Freshwater angling (migratory) | EXP, NM | |
| | | Estuarine & sea angling* | EXP, NM | |
| | | Bird watching (F) – v. few all wrong country apart from service value ones | EXP, NM | |
| | | Hiking | EXP, NM | |
| | | Water sports - not including scuba diving | EXP, NM | |
| | | Wildfowling recreation | EXP, NM | |
| | | Beach recreation | EXP, NM | |
| | As above & all recreational activities defined | destination (exc. all recreational values & views mentioned above and below) | EXP, NM | |
| Habitat provision | Habitat provision | Biodiversity (non-use values) | NM | Change biod** |

Change in Ecosystems Services

| Habitat - value type | Current situation | Immediate Effect (~2020) | | | | |
|---|-------------------|--|---------------------|-----------------------|---------------------------|-------------------------|
| | | Brean Down to Lavernock Point Barrage (B3) | Shoots Barrage (B4) | Beachley Barrage (B5) | Welsh Grounds Lagoon (L2) | Bridgwater Lagoon (L3d) |
| | | Saltmarsh | | | | |
| Area (ha) | | | | | | |
| Change from current situation (ha) | | | | | | |
| | | Intertidal mudflat | | | | |
| Area (ha) | | | | | | |
| Change from current situation (ha) | | | | | | |
| | | Grassland | | | | |
| Area (ha) | | | | | | |
| CO₂ equivalent flux (decrease in emissions after the STP option is implemented) | | | | | | |
| Change in CO ₂ equivalent tonne per year (decrease in emissions) | | | | | | |

Change in Value

Saltmarsh (total annual results in thousands)

| | | | | | | |
|--|--|--|--|--|--|--|
| Ha remaining | | | | | | |
| £/ ha / year low-high | | | | | | |
| £ Total Value / yr (thousands) low-high | | | | | | |
| £ value change / yr (thousands) from current situation low- high | | | | | | |

Scenario analysis – bundled approach

- High damage scenario
 - 1 ha habitat lost → all its ecosystem services lost, AND
 - All the services of the remaining habitat is lost
- Low damage scenario
 - 1 ha habitat lost → all its ecosystem services lost
 - Remaining habitat function as ‘without loss’



Multiple service approach – Forestry Commission Estate

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FC Estate in England

- Purpose: analyse 'economic contribution' from the estate, inform management
- Data averaged across the estate and time
- Typology of estate → factors affecting service and value:
 - Forest/woodland ecology
 - Proximity to users
 - Management
 - Access
 - Biodiversity

FC Estate in England

- Main sources of value from the forest estate are:
 - recreation
 - greenhouse gas regulation
 - aesthetic value
- Highlights tradeoffs & challenges, e.g.:
 - Recreation (close to populations with access) vs timber production
 - Open habitats for biodiversity vs carbon sequestration in woodlands

Reference:

- Published by the Forestry Commission England
- <http://www.forestry.gov.uk/forestry/infd-7yxk2h#economic> (see Economic Research)



Single service approach – Carbon valuation for the environmental impacts of the Severn Tidal Barrage Options

Calculating carbon emissions

- Data available for calculating the change of carbon emissions expected with each option.
- These emissions are not traded.
- DECC guidance (2010) values used for non-traded price of carbon.

Calculating the value of a change in carbon emissions

- Annual change in carbon emission for an option multiplied by the appropriate price

$$\triangle CO_2 \times Price_{CO_2} = \triangle \text{annual value}$$

- Over an entire project to year n

$$\sum_{2020}^n \triangle CO_2 \times Price_{CO_2} = \triangle \text{annual value}$$

- Discounting

Results

| | Current Level | Future Baseline (2020-2050) NO STP | Immediate Effect (~2020) | | | | |
|--|---------------|---------------------------------------|------------------------------|---------------------|-----------------------|---------------------------|--------------------------|
| | | | Brean Down to Lavernock (B3) | Shoots Barrage (B4) | Beachley Barrage (B5) | Welsh Grounds Lagoon (L2) | Bridgewater Lagoon (L3d) |
| Change in tCO ₂ e per annum | | | | | | | |
| 2020 (£) | | | | | | | |
| and so on | | | | | | | |

Ecosystem services – economic valuation

- Transparent way of presenting different types of information
 - ALL including but not limited to money
- Take account of synergies between services (and other trade offs)
 - Show us the complexities
- Take account of temporal and spatial distribution
- Decision making AND communication tool

We need to ...

- Have clear guidance from regulators
- Have sufficient and consistent common knowledge to adapt this guidance to the circumstances of individual decisions (and stakeholders)
- Learn to work with different types of data
- Learn the concepts, terminology and *boundaries* of all methods involved



Thank you!

- www.eftec.co.uk
- www.uknee.org.uk
- www.cowburps.wordpress.com



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