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*Institute for
Ocean Technology*

Oct 2005 : WHAT NEXT? critical developments

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National Research
Council Canada

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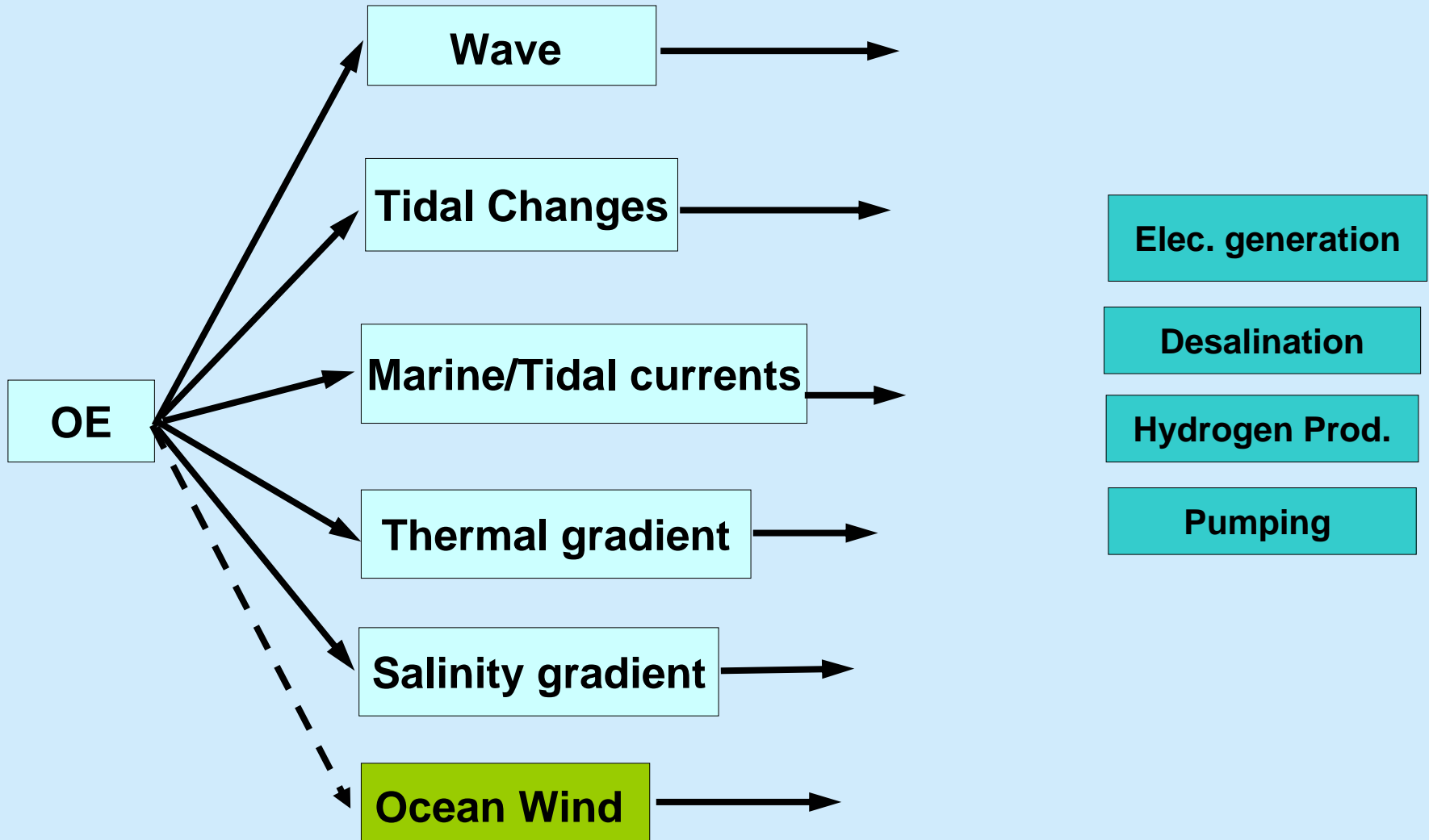
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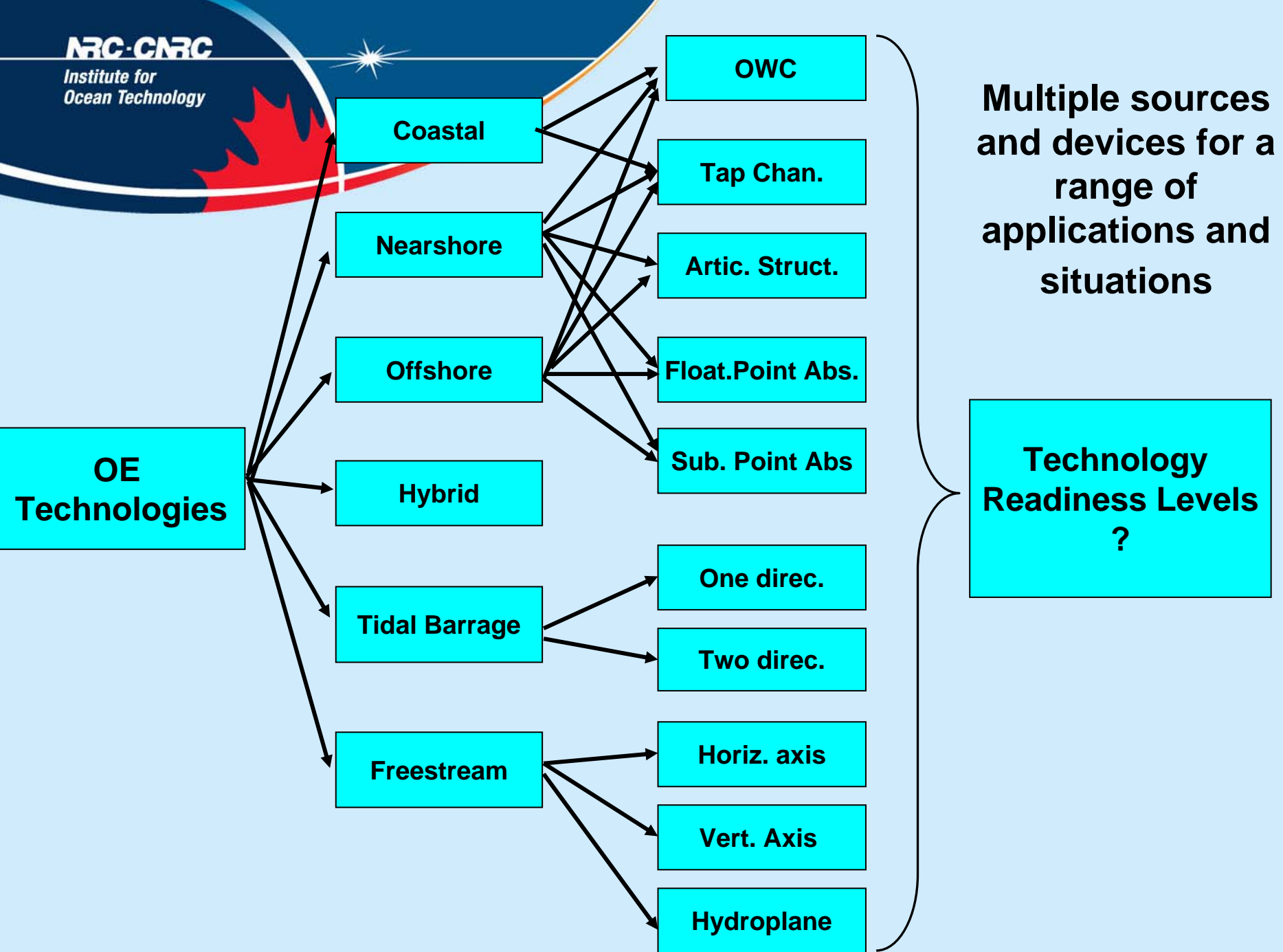
Renewable Energy

IMPACT

- **Clean and Sustainable Energy**
- **Diversified Technology**
- **Distributed Energy Resources**
- **Decentralized Energy Production**

Evolution of OES





Dti Status Report (2003)

	Concept only	Theoretical / model test	Scale prototype	Full-scale prototype	Ongoing research
Edinburgh Vertical Axis					●
Enermar					●
Seaflow					●
Stingray					●

Table 1 Snap-shot of the status of technical development of the main marine current concepts

Dti Status Report (2003)

	Concept only	Theoretical / wave tank	Scale prototype	Full-scale prototype	Ongoing research
Aqua Energy Aquabuoy					●
Archimedes Wave Swing					●
Backward Bent Duck Buoy					●
DWP Float Pump					
Energetech OWC					●
Floating Wave Power Vessel					●
Hosepump (Swedish)					
Limpett OWC					●
McCabe Wavepump					●
Mighty Whale					
Osprey					
Pelamis					●
Pendulor					
Pico Azores OWC					●
Point Absorber (Danish)					
PS Frog					
Salter Duck					
Sloped IPS Buoy					●
Sperboy					●
TAPCHAN					
TMOWC					●
Unión Eléctrica Fenosa OWC					●
Wave Dragon					●
Wave Plane					●
Wave Rotor					●
Wavebob					●
WaveGen Project X					●

Table 2 Snap-shot of the status of technical development of the main wave energy concepts

Wave Energy Centre Portugal

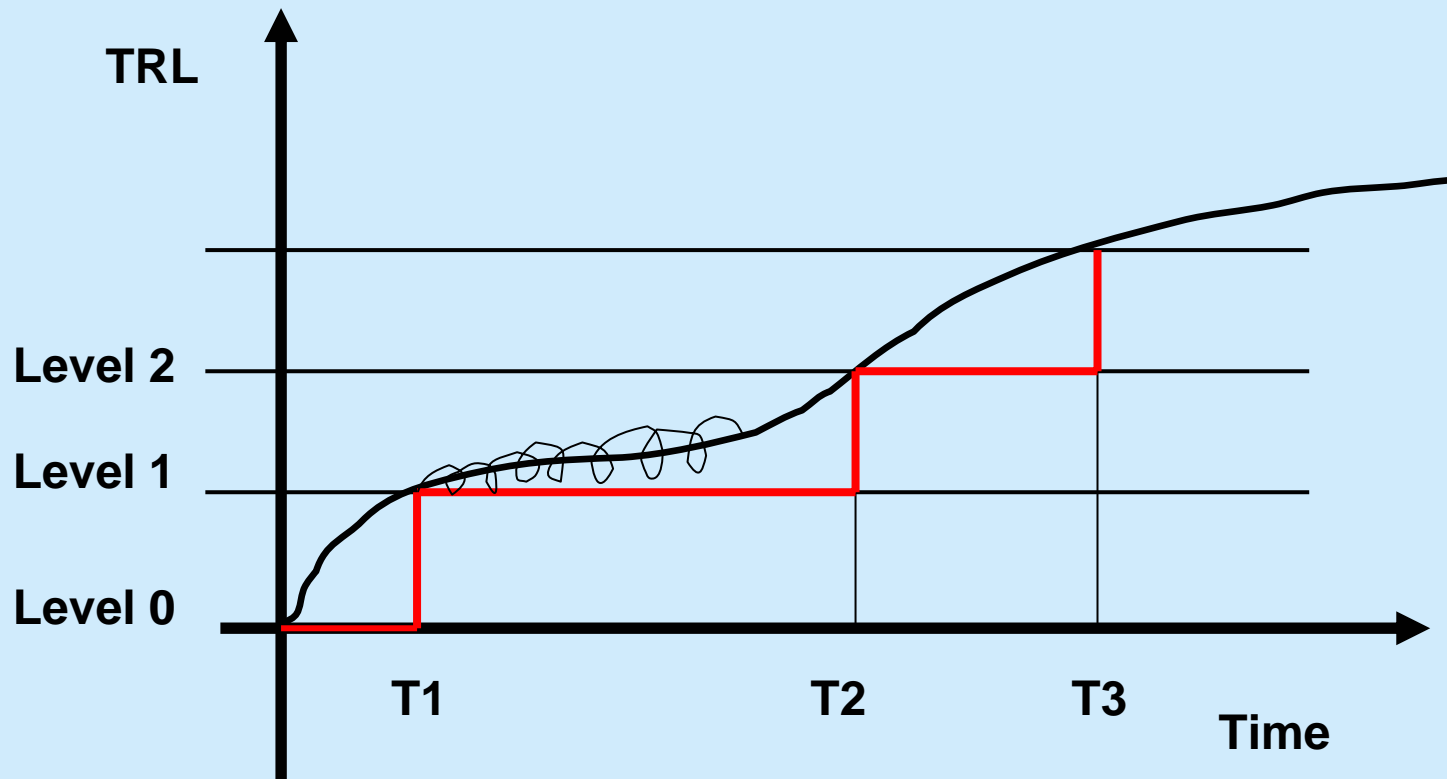
references : WEC, LIMPET, PELAMIS OPD, WAVEDRAGON, & AWS
Teamwork.



Technology Readiness Levels

- Well defined process
- Need to be defined for OES
- Flexible or standardized ?
- Not full proof : an approximation
- Guide for developers, regulators, funding agencies, VC
- Step wise, iterative approach, combining:
 - **Initial proof of concept**
 - **Theoretical / computational analysis and Laboratory testing : components (soft and hard) and integrated system**
 - **Scale modeling : Physical / Numerical : verification**
 - **Reduced scale and full scale prototype field trials : validation**
 - **Demonstration in full operational environment : single and farm configurations**
 - **TRL should also include : regulatory, business and market components**

Technology Readiness Levels



Testing and TRL

- Testing and performance monitoring capabilities:
 - Lab : physical and numerical models for verification, validation, prediction : components and integrated systems
 - Full scale testing centre : monitoring
 - Mobile testing capability : monitoring field trials
- What to do with the data ? (hard and soft) : lessons learned
- Who pays ?
- Highly Skilled Personnel: training, education
- Guidelines for design and operations of OE systems
- Certification : Is it needed ?
- “Successful” demonstrations of technology in multi-device farm (FP6 and FP7)

So ...

- **There is not a single ocean power technology.
What type of technology and at which size will it yield optimal economics?**
- **Will the performance, reliability and cost projections be realized once ocean energy devices are deployed and tested ?**
- **TRL could help the evolution process :**
- **The Limpet, Pelamis, Dragon, MightyWhale, Osprey, ... and the other “species” have to evolve to “maturity” and compete? More than one approach could co-exist? or conscious selection ?**
- **“Maturity” : Technology maturity, business and market maturity**
- **Move from single optimized device to multi-device farms**



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Thank you

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