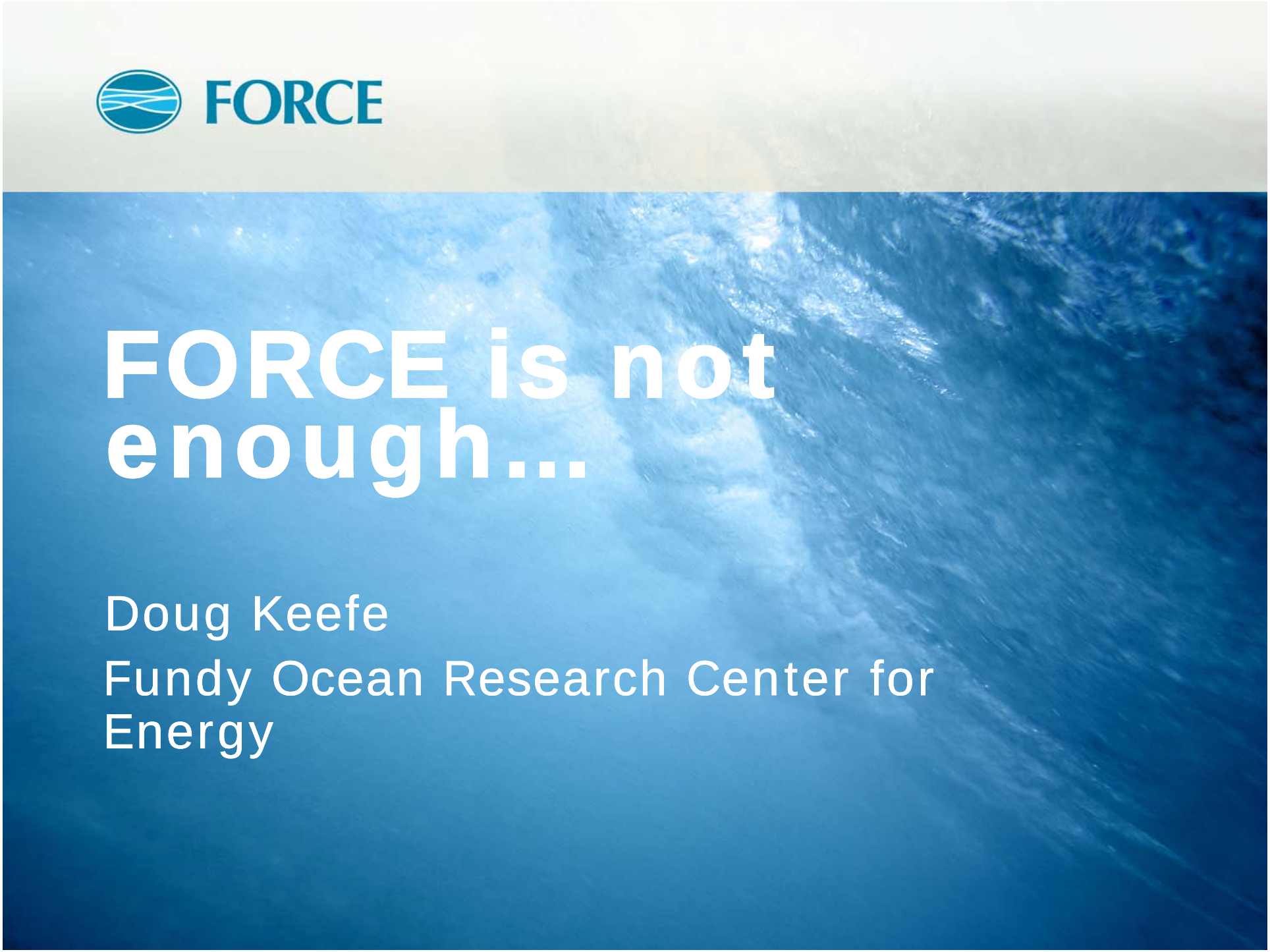
FORCE
FORCE is not enough...
Doug Keefe
Fundy Ocean Research Center for Energy

Forming, funding, facilities

Jan 2008	FORCE: Prov $7m Encana $3m +$1m
Sept 2009	Fed/prov EA approvals
Nov 2009	NSP | OH deploys turbine
March 2010	CEF $20m
Dec 2010	OH turbine recovered
Oct 2011	Cables arrive Saint John
Nov 2011	Visitor centre opening
Fall 2012	Cable lay rehearsals
Oct 2012	Substation & T-line complete

Facilities, facilitating

2013	• Deploy 1st cable & monitor • Develop FAST infrastructure & trial • FIT & regulations
2014	• Deploy 3 cables • Deploy FAST infrastructure
2015	• Turbine deployment

Five essentials

1. Suite of commercial techs & services
2. ROI that supports investment
3. Legal/insurance to protect investment
4. Energetic site that's well understood
5. Confidence of public, regulators, investors, industry

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1. Suite of techs & service

- Accelerate innovation
  - Common facilities
    - Turbines
    - Sensors
    - Tools
  - Research
  - Standards
  - Publish evaluation/rating

2. ROI

- FIT
- Subsidy (negative royalty)
  - Direct
  - Research
  - Research facilities
  - Infrastructure

3. Legal & insurance

- MRE legislation
  - Tenure
  - Clear path
  - Environmental, social, & development relationship

4. Energy characterized

- Energy: Minas Passage
- ADCP program
- Modeling & analysis
- FAST

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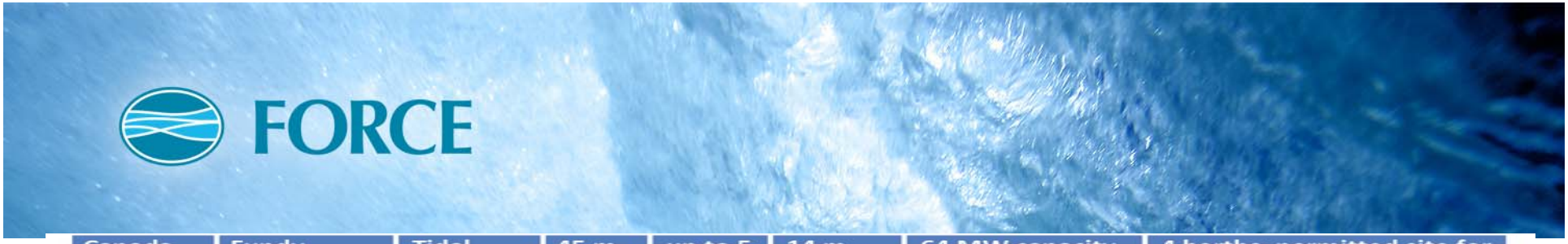
5. Confidence

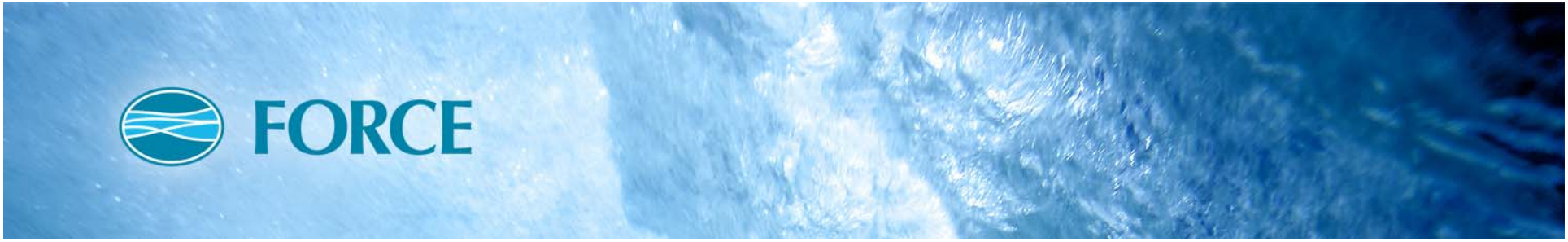
- Environmentally benign?
  - EEM
  - EMAC
  - Research (FERN, OERA)
- Resource & site characterization – FAST

The competition…

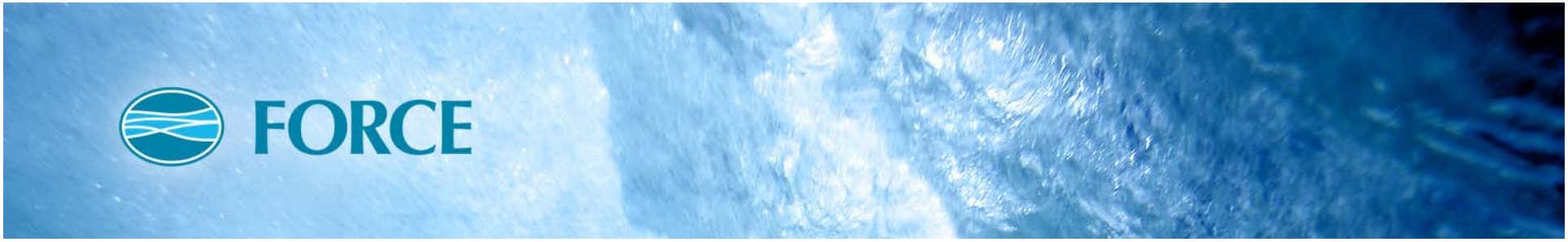
Courtesy of Marine Renewables Canada



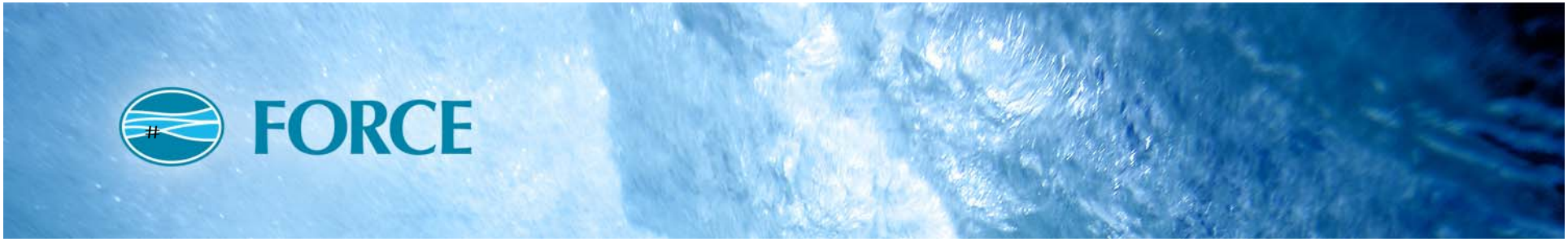
Canada	Fundy Ocean Research Center for Energy (FORCE)	Tidal	45 m	up to 5 m/s	14 m (avg tidal range)	64 MW capacity subsea cables to be installed Substation and transmission line at 132kV	4 berths, permitted site for up to 5 MW, environmental monitoring, ongoing research and development activities.
France	Paimpol Brehat (France Energies Marine)	Tidal	30-45m	2.6 m/s (spring tide)	10 m	Export cable: 8MVA-10kVDC Hub connection: 1MVA-690VAC	2 berths Test performance reliability of tidal devices; develop and test new sub-systems (instrumentation, connectors, etc.); conduct research on environmental impact
France	Sem-Rev (France Energies Marine)	Wave	35-40m	12 kW/m	n/a	Export cable: 8MVA-20kv	Test performance and reliability of wave energy devices
France	Seeneoh (France Energies Marine)	Tidal	8m+	3.5 m/s		Export cable: 690 VAC-100 kW	3 berths; tidal estuarine test site; test performance and reliability; analyze environmental impacts
Japan	JMEC						Under development; being created in collaboration with EMEC
Netherlands	Dutch Tidal Testing	Tidal	4.2m	1.4-4.5 m/s		160 kVa	Performance testing for intermediate scale devices



Norway	**Danish Wave Energy Centre (DanWEC)**	**Wave**			**n/a**		**Established in 2009**
Portugal	Aguacadoura	Wave	45m		n/a	4 MW subsea cable	3 berths – Pelamis wave devices deployed in 2008 Onshore electrical infrastructure
Portugal	Wave Energy Centre/ Pico Wave Energy Plant	Wave	7m		n/a	Up to 700 kW	Private non-profit association formed by 8 companies and 3 R&D institutions.
Portugal	Pilot Zone	Wave	30-90m		n/a	Subsea cable not included. Plans for 3 phases: • Demonstration, up to 4MW • Pre-commercial, up to 20MW • Commercial, no power limit	Licensing of wave projects; may expand to offshore wind first-come-first served basis
Spain	The Biscay Marine Energy Platform	Wave	50-90m	21 kW/m	n/a	20 MW capacity Subsea cables: 13.2 kV/F MW Onshore	4 berths; Connectors to make easier the connection and disconnection of WECs; Research and data centre.



Spain	**Santona Test Centre**	**Wave**	**48-55m**			**1.5 MW**	**Plans to accommodate test site for wave device prototypes; would accommodate up to 10 devices** **Joint Venture led by Iberdrola €8 million budget**
Spain	Ubiarco Test Centre	Wave	45 – 130m			Planned 20 MW	Plans for 4 floating devices
United Kingdom	European Marine Energy Centre	Tidal Wave	25-50 m	1.3-3.4 m/s	3 m	11 kV control & switching stations	14 full-scale test berths; 2 scale test sites and 2 nursery sites Supervisory, control and data acquisition (SCADA) system Weather stations (MET) that feed into SCADA CCTV monitoring
United Kingdom	Narec	Tidal Wave Wind	n/a	n/a	n/a	n/a	Onshore testing scale prototypes
United Kingdom	WaveHub	Wave Offshore wind	60-100 m	Wind speed of 10 m/s		25 km of 11/33kv subsea cable for up to 20 MW of wave energy	4 berths up to 5 MW each; fully monitored and permitted site; Upgradable to 50 MW once 33 kV has



United Kingdom - Ireland	**Galway Bay**	**Wave**	**23m**	**2.5kW/ m2**	**4m**	**In planning**	**2 berths; ¼ scale prototype test site; permitted.** **Hosts SmartBay which supports innovation in the field of marine sensing, data management and communications.**
United Kingdom – Ireland	AMETS, Belmullet, Co Mayo	Wave	50-100m	45-50 kW/m2		10 MW export capability	Full scale grid connected wave energy test site.
United States	Hawaii National Marine Renewable Energy Center	Wave					3 test sites for commercial size devices ranging from 300-500 kW, ongoing research activities.
United States	Northwest National Marine Renewable Energy Center	Tidal Wave	Newport: 40-50m Puget Sound : 16m				Permitted sites Tidal-3 grid connected berths Wave- planning for 2 MW
United States	Southeast National Renewable Energy Center	Tidal Thermal				Not grid connected	Small-scale limited-duration deployments; research and activities focused on resource assessment, environmental interactions, and outreach/education.

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Programs

Country	Financial Support	Details	Value
Canada	R&D Funding	Clean Energy Fund	Est $30+m
	R&D Funding	ecoEII	Est. $10m
	R&D Funding	Offshore Energy Research Association	Est $3m
	Innovation investment	Sustainable Development Technologies Canada	Est $20-30m
	Feed-in Tariff	Nova Scotia array demonstration	To be set in 2013
	Feed-in Tariff	Nova Scotia Community-Based Feed-in Tariff	65.2 c/kWh
France	Feed-in Tariff		260-76 €/kWh
	Infrastructure funding	Port of Brest – development for MRE	134m€
United Kingdom	Capital grant	Marine Renewables Deployment Fund (MRDF)	£ 42 million
	Grant	Marine Renewable Proving Fund	£22 million
	Capital grant	Department of Energy and Climate Change - Marine Energy Array Demonstrator (MEAD)	£20 million
	R&D Funding	Technology Strategy Board	£10.5 million
	R&D Funding	Carbon Trust – Marine Renewables Commercialization Fund	£18 million
	R&D Funding	Energy Technologies Institute	£ 25.5 Million (approx.)
	R&D Funding	SuperGen	€3 million
	Grant	Saltire Prize (Scotland)	£ 10 Million
	Capital grant (Scotland)	Wave & Tidal Energy Support Scheme	£ 15 Million
	ROC/FIT	5 ROCs for wave and tidal Renewable Obligation Certificates (ROCs)	approx £210 pounds for 5 ROCs
	Capital Grant	Prototype Development Fund (Ireland)	€10 million

Two points

- Total spending (no FIT)
  - Canada $70m
  - UK $240m
  - France $175m
- Strategic institutions
  - UK: Carbon Trust, ETI, SuperGen…
  - France-Energies-Marines

Business case follows the political case

- Canada: a lot of nautical metaphors
  - At sea
  - missing the point,
  - adrift,
  - but not yet up the creek.
- ┬Up to us to ensure the Bay doesn't miss the boat

Pessimists on Canada

- Landlocked people: c.20% near coast
- Cutbacks in federal funding
- Intolerance of science/research
- Environmental denial
- NS ratepayers vs. UK & France

Canada…

- 0.3% of global ship exports.
- 1.5% of global ship imports
- No Canadians in top ship design firms.
- Shipbuilding: Irving and Seaspan.
- 5th exporter of underwater instruments in 2010.
- NS active in sensors, leading multinational and local firms

Optimists on Canada

- Alberta discovers the ocean
- Rise of Asia/slowdown in US
- Ship building & Northern strategy
- Good core in NRCan & NS
- Won’t take much $$$
- Cooperate and don’t say we don’t

Asteroids of excellence

- FORCE
  - World class resource & facility
  - 3 elite techs
- FIT & MRE legislation
- Research
  - FERN, FORCE, OERA
  - FTI, Acadia, and Dal
  - All the people in this room today!

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What to do?

- Learn by doing
  - Work with Worlds' best
  - Turbines: means not an end
- Focus
  - Site characterization & monitoring
  - Deployment, vessels, foundations
- Attract established Cdn industries
- Lobby for a strategic MRE body

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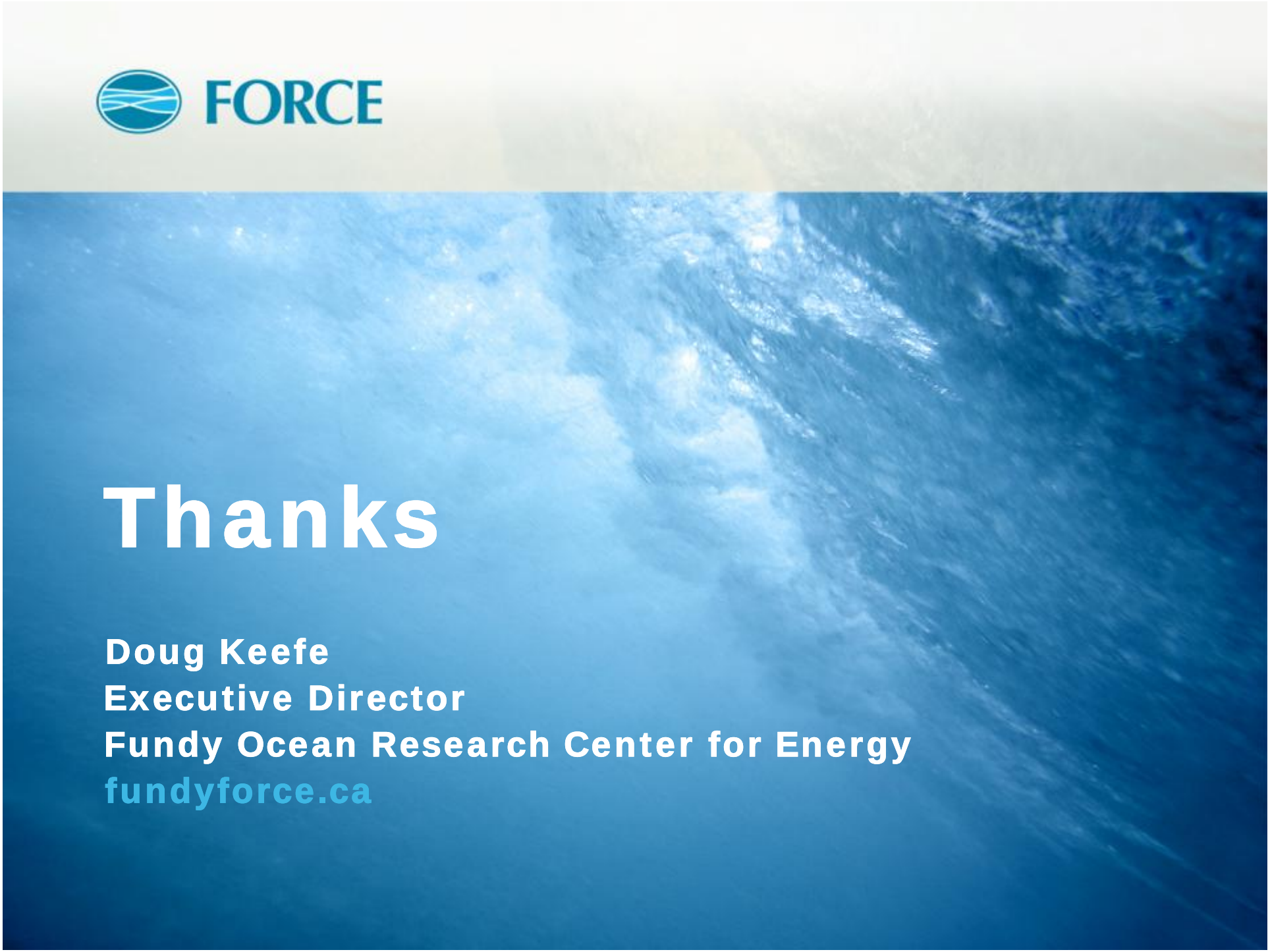
A strategic institution

- Consortium of business, academic & research institutions for MRE to link government, research & business
- Prioritize & direct
  - Research
  - Funding & facilities
  - Public policy
  - Government relations
  - International & intersectoral collaboration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Thanks
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