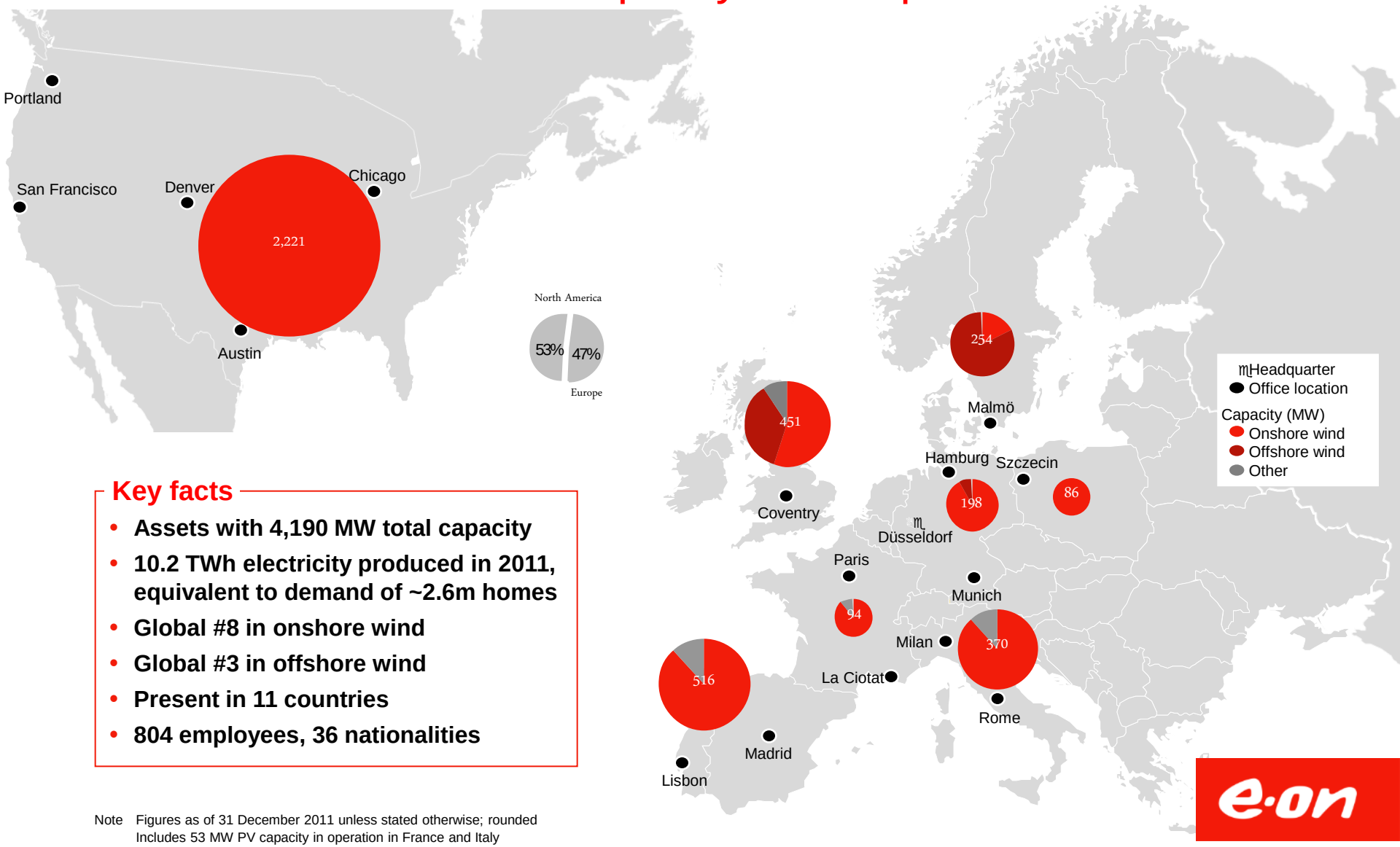
Chris Smith
Technical Contracting
Asset Management
E.ON Climate and Renewables

Wind Turbine Warranty Operating Issues
Experience and Lessons Learnt

EC&R currently operates a geographically balanced portfolio of 4.2 GW renewables capacity in Europe and North America



Key facts

- **Assets with 4,190 MW total capacity**
- **10.2 TWh electricity produced in 2011, equivalent to demand of ~2.6m homes**
- **Global #8 in onshore wind**
- **Global #3 in offshore wind**
- **Present in 11 countries**
- **804 employees, 36 nationalities**

Note Figures as of 31 December 2011 unless stated otherwise; rounded
Includes 53 MW PV capacity in operation in France and Italy
Includes 25 MW CSP capacity in operation in Spain (further 25 MW operational since January 2012)

Lessons Learned – Summary

1. **WTG Warranty Contract Preparation is Essential**
2. **WTG Warranties can Encourage the Wrong Behaviours**
3. **WTG Warranties can Influence Turbine Selection**
4. **End of Warranty Preparation comes to late**
5. **Limited Exploration of Alternatives to WTG Warranties?**

Warranty Management Objectives

Return on Investment

- 20-25 year Return that meets your Investment Predictions?
- A Suitable Investment Return on your Warranty Fee?

Using the Warranty Period Effectively

- Separating WTG Performanace from WTG Maintenance
- Capturing Turbine Operating and Maintenace Data
- Ensuring High Quality, Long Term Asset Management
- Robust Onwer Contract Management

Business Strategy & Objectives

- Highest Performance at Lowest Cost
- Prepared for Business Changes - Internal or External
- Managed Risks
- Predicable Operation and Returns

4

Return on Investment

What do you expect from the Turbines that you purchased under your Turbine Supply Agreement?

Energetic Performance (Yield, Availability = MW)
WTG Reliability
Owners Capability to Monitor and Operate the Assets?

So what do you now need from your Warranty Service Agreement (O&M)?

Setting in place your Asset Management Strategy

Using the Warranty Period Effectively

What do you need your warranty period the achieve for you?

ASSET OWNER LEARNING:

Provide Detailed Turbine Records
(Operating data, service records, trends, etc)
Serial and Major Component Defect correction
WTG Upgrades
Long term cost and resource planning

ASSET OWNER EXPECTATIONS:

Establishing good asset management practices

Business Strategy & Objectives

What is your Business Strategy for Wind O&M?

Is your business clear about this?

How do you begin to enact this through your warranty?

How should this influence your warranty planning and management?

Pre-Handover Warranty Preparation
Construction to Operations Handover
Tracking Warranty Management Plan
Post Warranty Planning and Management